

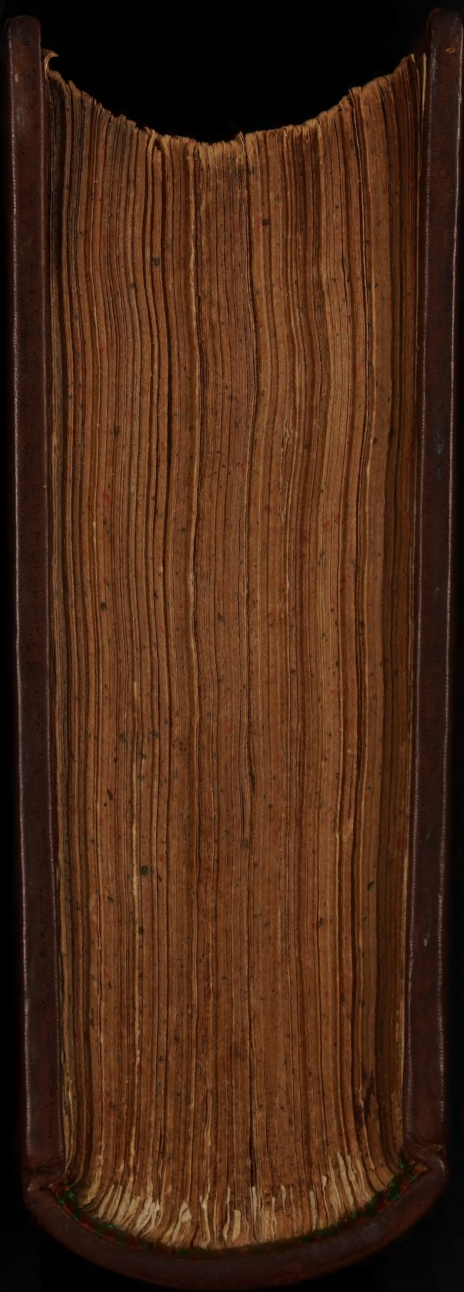


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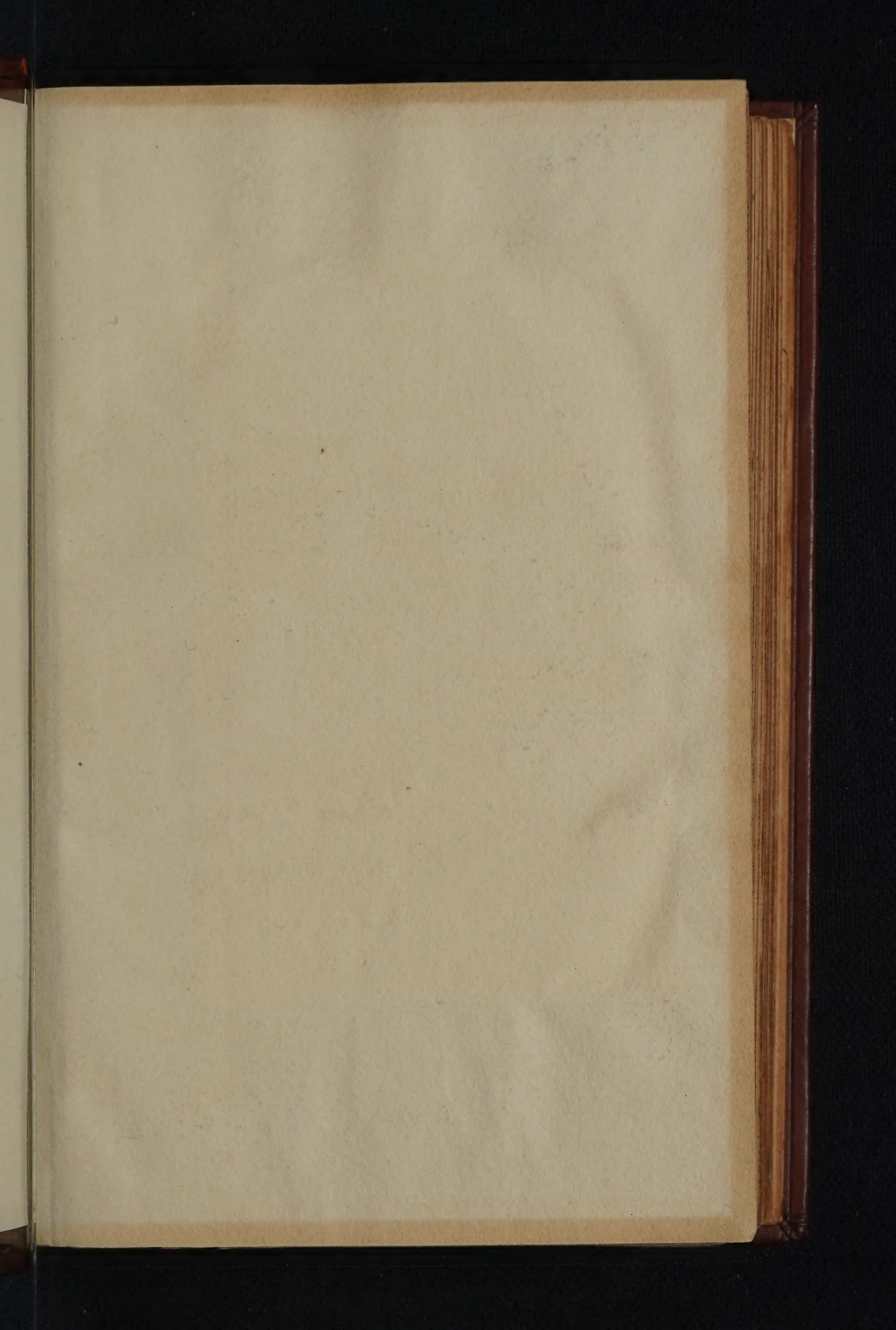






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A N
E S S A Y
Of the Great
E F F E C T S
O F
Even Languid and Unheeded
MOTION.

Whereunto is Annexed

An Experimental Discourse
of some little observed Causes of the
Insalubrity and Salubrity of the Air
and its Effects.

By the Honourable *ROBERT BOYLE*,
Fellow of the Royal Society.

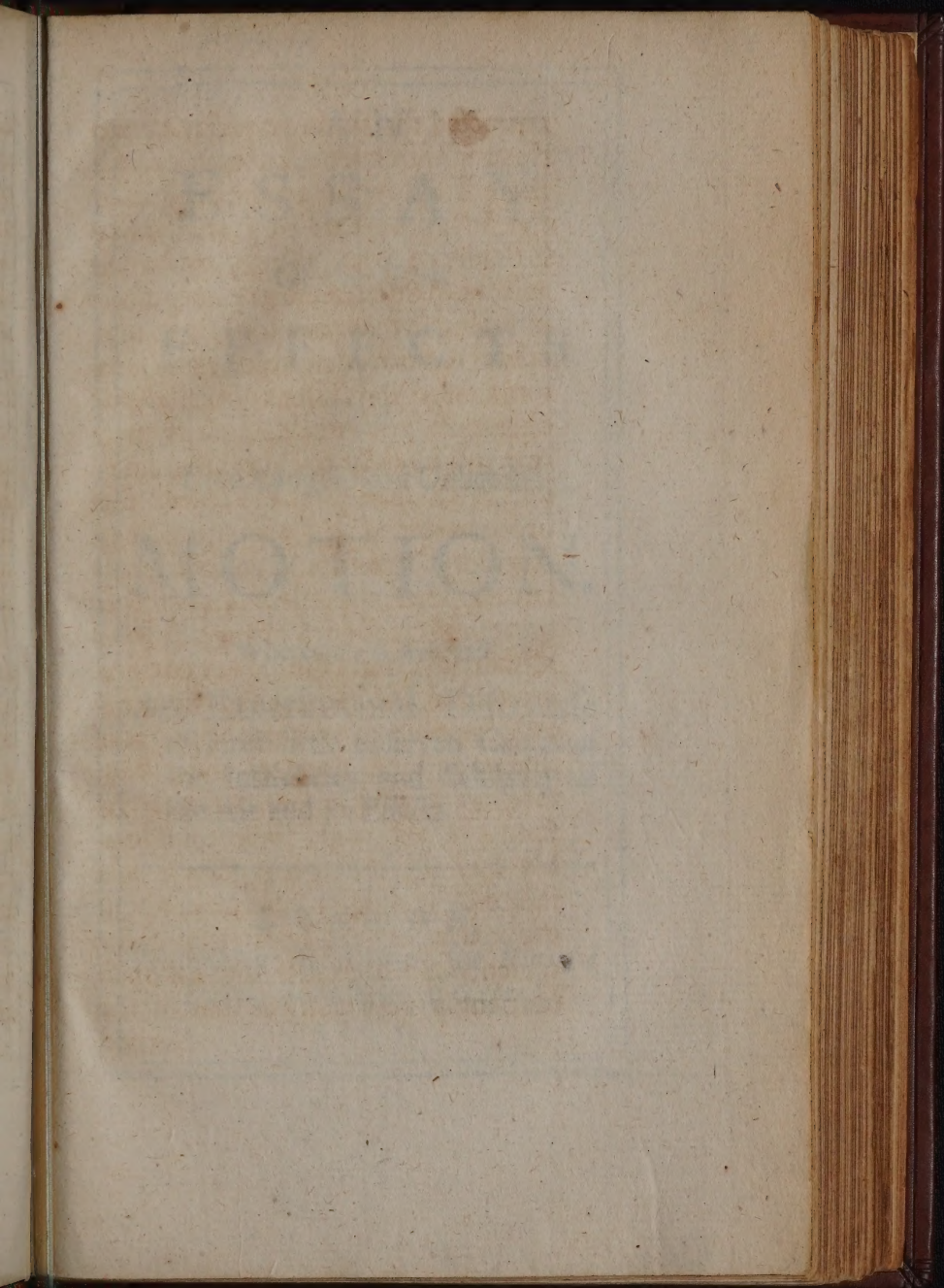
L O N D O N,
Printed by *M. Flesher*, for *Richard Davis*,
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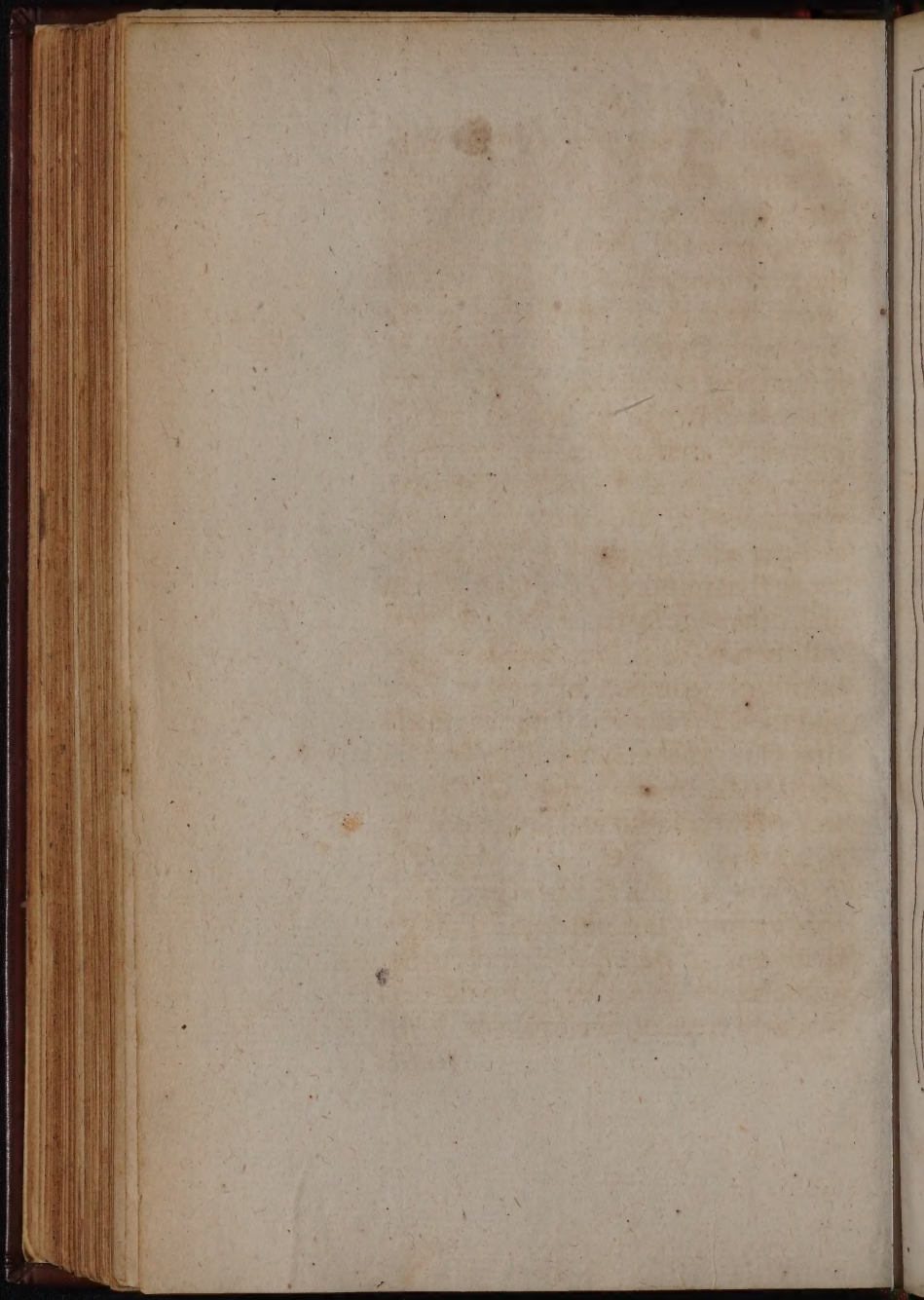
ESSAYS
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EFFECTS
OF
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An Experiment, Discourse
of some time observed Causes of the
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By the Honorable ROBERT ROYLE,
Fellow of the Royal Society.

LONDON:
Printed by A. K. for R. and J. D. 1734.





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ADVERTISEMENT

OF THE

Publisher.

TIS thought fit
the Reader
should be in-
form'd, That the insuing
Tract (about the Effects
of Languid Motions) was
design'd to be a Part of the
Authour's Notes about the
Origine of Occult Quali-

A 2 ties,

Advertisement of

ties, and should have come abroad together with the Papers about the Effluvia of Bodies (most of which are already publish'd.) And accordingly it was printed seven or eight years ago: which Circumstance is here mention'd, to give a Reason why several Particulars were omitted in the Body of the Discourse, that will be found annex'd to the End of it. For these occurring to the Author whilst he cursorily read over the Tract it self, when

it

the Publisher.

it was upon the point to be made publick, 'twas thought fit rather to subjoin them by way of a short Appendix, than to let any thing be lost that seem'd pertinent to so difficult and uncultivated a Subject, as That they belong to. The Reader is farther to be advertis'd, That of the Three Preliminary Discourses, which the Authour intended for Introductory Ones to What he design'd to say more particularly about the Mechanical Origine or Pro-

Advertisement of
Production of Occult
Qualities, *One was con-
cerning the Relations be-
twixt the Pores of Bo-
dies and the Figures of
Corpuscles: but that the
great Intricacy and Diffi-
culty He found in this co-
pious Subject, made Him
consent, That the Dis-
course of Local Motion,
which should have accom-
pany'd it to the Press,*
should be printed long before
it. And those Papers about
Pores and Figures having
been for a great while out
of

the Publisher. BA

*of the Authour's Power,
He now to gratify the Sta-
tioner with something that
may in Their stead make up
the formerly printed Essay a
Book of a convenient Bulk,
has put into his Hands what
now comes forth, about
some Unheeded Causes of
the Healthfulness and In-
salubrity of the Air :
which being chiefly attribu-
ted to Subterranean Steams,
Subtile and for the most part
Invisible, are as near of kin
to the other Effluvia
treated of in the Introducto-
ry*

Advertisement of, &c.
ry Discourse, as is requisite
to keep the mention that is
made of them in this Book,
from appearing very incon-
gruous.

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AN

ESSAY

Of the Great

EFFECTS

Of

Even *Languid* and *Unheeded*

LOCAL MOTION.

CHAP. I.

HOW superficially soever the
Local Motion of Bodies is
wont to be treated of by the
Schools, who admit of divers other
Motions, and ascribe almost all strange
things in Physicks to *Substantial Forms*
and *Real Qualities*; yet it will be-
come Us, who endeavour to resolve
the *Phænomena* of Nature into Matter

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and Local motion, (*guided*, at the beginning of things, immediately, and since *regulated*, according to settled Laws, by the Great and Wise Author of the Universe,) to take a heedfull notice of its kinds and operations, as the true Causes of many abstruse Effects. And though the industry of divers late Mathematicians and Philosophers have been very laudably and happily exercised on the nature and general Laws of this Motion; yet I look upon the Subject in its full extent to be of such importance, and so comprehensive, that it can never be too much cultivated, and that it comprises some parts that are yet scarce cultivated at all. And therefore I am not sorry to find my self obliged, by the design of these Notes, (written, as you know, to facilitate the explicating of *Occult* Qualities) to endeavour to improve some neglected Corners of this vast field, and to consider, Whether, besides those effects of Local motion which are more conspicuous, as being produced by the
mani-

manifest striking of one body against another, where the bulk, &c. of the Agent, together with its Celerity, have the chief Interest; there may not be divers effects, wont to be attributed to Occult Qualities, that yet are really produced by *faint or unheeded* Local motions of bodies against one another, and that oftentimes at a distance.

But, before I enter upon particulars, this I must premise in general, (which I have elsewhere had occasion to note to other purposes,) that we are not to look upon the bodies we are conversant with, as so many Lumps of Matter, that differ onely in bulk and shape, or that act upon one another merely by their own distinct and particular powers; but rather as bodies of peculiar and differing internal Textures, as well as external Figures: on the account of which structures, many of them must be considered as a kind of Engines, that are both so framed and so placed among other bodies, that sometimes Agents, otherwise in-

valid, may have notable operations upon them, because those operations being furthered by the Mechanism of the body wrought on, and the relation which other bodies and Physical Causes have to it, a great part of the effect is due, not precisely to the external Agent, that 'tis wont to be ascribed to, but in great measure to the action of one part of the body it self (that is wrought on) upon another, and assisted by the concurring action of the neighbouring bodies, and perhaps of some of the more Catholick Agents of Nature. This Notion or Consideration being in other Papers particularly confirmed, I shall not now insist upon it, trusting that you will not forget it, when there shall be occasion to apply it in the following Notes.

There may be more Accounts than we have yet thought of, upon which *Local motions* may perform considerable things, either without being much heeded, or without seeming other then faint, at least in relation to the

the considerableness of the Effects produced by them. And therefore I would not be understood in an exclusive sense, when in the following Discourse I take notice but of a few of the above-mentioned Accounts; these seeming sufficient, whereto, as to Heads, may be conveniently enough referred the Instances I allot to this Tract.

And concerning each of these Accounts, I hold it requisite to intimate in this place, that I mention it onely, as that whereon such effects of Local motion, as I refer to it, do principally depend: for, otherwise, I am so far from denying, that I assert, that in divers cases there are more Causes than one, or perhaps than two of those here treated of apart, that may notably concur to *Phænomena* directly referred to but one or other of them.

To come then closer to our subjects; I shall take notice, That among the severall things, upon whose account men are wont to overlook or under-

value the efficacy of Local motions, that are either Unheeded or thought Languid, the chief, or at least those that seem to me fittest to be treated of in this Paper, are those that are referable to the following Observations.

CHAP. II.

Observat. I. *Men are not usually aware of the great efficacy of Celerity, even in small Bodies, and especially if they move but through a small space.*

WHat a rapid Motion may enable a Body to doe, may be judged by the powerfull and destructive Effects of Bullets shot out of Cannons, in comparison of the Battering Engines of the Ancients, which, though I know not how many times bigger then the Bullets of whole Cannon, were not able to batter down Walls and Towers like Bullets, whose bulk compared with theirs is inconsiderable. Other examples of

of a like nature might be without impertinency alledged on this occasion; but, because the latter part of our Proposition contains that which I chiefly aim at, I shall proceed to Instances fit to prove That.

I have sometimes caused a skilfull Turner to turn for me an oblong piece of Iron or Steel, and placing my naked hand at a convenient distance to receive the little fragments, perhaps for the most part lesser then small pins heads, as they flew off from the rod, they were, as I expected, so intensely heated by the quick action of the Tool upon them, that they seemed almost like so many sparks of fire; so that I could not endure to continue my hand there. And I remember, that once asking an expert workman, whether he (as I had sometimes done) did not find a troublesome heat in the little fragments of Brasse that were thrown off when that metall was turning? He told me, that heat was sometimes very offensive to his eyes and eye-lids. And

when I asked, whether it was not rather as Dust cast into them, than from their Heat; he replied, that besides the stroke, he could sensibly feel a troublesome heat, which would make even his Eye-lids sore: And that sometimes, when he employed a rough Tool, that took off somewhat greater Chips, he had found the heat so vehement, that not onely 'twould scorch his tender Eye-lids, but the thick and hard skin of his hands: for proof whereof he shewed me in one of his hands a little blister, that had been so raised, and was not yet quite gone off.

And inquiring about these matters of a famous Artist, imployed about the finishing up of cast Ordnance, he confess'd to me, That, when with a strong as well as peculiar Engine he and his associates turned great Guns very swiftly, to bring the surface to a competent smoothness, the tools would sometimes throw off bits of metal of a considerable bigness, which, by reason of their bulk and their rapid motion, would be so heated as to burn the

the fingers of the Country-people that came to gaze on his work, when he, for merriment sake, desired them to take up some of those pieces of metall from the ground. Which I thought the more remarkable, because by the Contact and Coldness of the ground I could not but suppose their Heat to have been much allayed. Not to mention, that I learnt from an experienced Artificer, that in turning of Brass the little fragments of that metall acquire an intenser Heat than those of Iron.

I remember also, that, to vary the Experiment mentioned just before this last, by making it with a bodie far less solid and heavy than Brass or Iron, I caused an Artificer to turn very nimbly a piece of ordinary wood, and holding my hand not far off, the powder, that flew about upon the operation, struck my hand in many places with that briskness, that I could but uneasily endure the Heat which they produced where they hit. Which Heat whether it were com-

mu-

municated from the little, but much heated, fragments to my hands, or produced there by the brisk percussioⁿ on my hand, or were the joint effect of both those Causes; it will however be a good Instance of the power of *Celerity* even in very small bodies, and that move but a very little way.

'Tis considerable to our present purpose, that by an almost momentany percussioⁿ, and that made with no great force, the parts, even of a vegetable, may be not onely intensely heated, but brought to an actual Ignition; as we have severall times tried, by striking a good Cane (of that sort which is fit for such Experiments) with a steel, or even with the back of a knife. For, upon this Collision, it would send forth sparks of fire like a flint.

To the same purpose may be alledged, that, by but dextrously scraping good loaf-sugar with a knife, there will be made so brisk an agitation of the parts, that store of sparks will

will be produced. But that is more considerable, which happens upon the collision of a flint and a steel: For, though Vitrification be by Chymists esteemed the ultimate action of the fire, and though, to turn sand or stones, though very finely powdered, into glass, 'tis usually required that it be kept for divers hours in the intense fire of a glass-house; and though, lastly, the glass-men complain, that they cannot bring flints or sand to fusion without the help of a good proportion of *Borillia* or some other fixed salt: yet both actuall Ignition and Vitrification are brought to pass almost in a moment by the bare vehemence of that motion that is excited in the parts of a flint when it is struck with a steel: For those sparks that then fly out, (as an Ingenious person has observed, and as I have often seen with a good Microscope,) are usually real and permanent parcels (for the most part globulous) of stone vitrified and ignited by the vehemence of the motion. And that
this

Mr. Hooke.

this vitrification may be of the stone itself, though steel be a metal of a far more fusible nature than a flint, I am induced to think, because I have tried, that not only flints with steel, but flints with flints, and more easily pieces of Rock-Crystal between themselves, will by collision strike fire. And thelike effect of collision I have found my self in some precious stones, harder than Crystall. And afterwards inquiring of an ingenious Artificer that cuts Diamonds, Whether he had not observed thelike, when Diamonds were grated on by the rapid motion of his mill? He replied, that he observed Diamonds to strike fire almost like Flints; which afterwards was confirmed to me by another experienced cutter of Gems; and yet having made divers trials on Diamonds with fire, he would not allow that fire itself can bring them to fusion.

Nor are fluid Bodies, though but of small Dimensions, to be altogether excluded from the power of making considerable impressions on solid bodies,

bodies, if their celerity be great.

Whether the Sun-beams consist, according to the Atomical Doctrine, of very minute Corpuscles, that continually issuing out of the body of the Sun, swiftly thrust on one another in Physically-straight Lines; or whether, as the *Cartesians* would have it, those beams be made by the brisk action of the Luminary upon the contiguous fluid, and propagated every way in straight lines through some Ethereal matter harboured in the pores of the Air; it will be agreeable to either *Hypothesis*, that the Sun-beams, refracted or reflected by a burning-glass to a *focus*, do there, by their concurrence, compose a small portion of fluid matter; and yet the *Celerity*, wherewith the soft and yielding substance is agitated, enables so few of them as can be circumscribed by a Circle, not a quarter of an inch in Diameter, to set afire green wood in less than a minute, and (perhaps in as little time as that) to melt not onely Tinn and Lead thinly
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beaten, but, as I have tried, foliated Silver and Gold.

The operation of small portions of fluid matter on solid bodies will be farther exemplified in the IV. *Chapter*, by the effects of the blown flame of a Lamp on glass and metals; so that I shall here need but to point in general at the wonderful effects that *Lightning* has produced, as well by the Celerity of its motion, as by the matter whereof it consists. Of which Effects, Histories and the writings of Meteorologists afford good store; and I have been an admiring observer of some of them, one of the last of which was the melting of metal by the flame in its passage, which probably lasted but the twinkling of an Eye.

And even a small parcel of Air, if put into a sufficiently-brisk motion, may communicate a considerable motion to a solid body; whereof a notable Instance (which depends chiefly upon the Celerity of the springy corpuscles of the Air) is afforded
by

by the violent motion communicated to a bullet shot out of a good wind-gun. For, when this Instrument is well charged, the strongly-comprest Air being set at liberty, and forcibly endeavouring to expand it self to its wonted laxity, its corpuscles give a multitude of impulses to the bullet, all the while that it continues moving along the barrel, and by this means put it into so rapid a motion, that I found by trial, the bullet would in a moment be flatted, almost into the figure of a Hemisphere, by being shot off against a metalline plate.

And farther to shew, How swift that motion must have been, and with what Celerity a vehement agitation may be communicated to the parts of a Solid body, I shall add here (though the *Phænomenon* might be referred to the V. Chapter,) that, though the contact of the Bullet and the metalline plate lasted probably but a physical moment; yet the minute parts of the bullet were put into so various and brisk an agitation, that making hast

to take it up before it should cool,
I found it too hot to be with over-
much ease held between my fingers.

CHAP. III.

Observat. II. *We are too apt to think, that Fluid bodies, because of their softness, cannot have by their bare motion, especially if insensible, any sensible effect upon Solid ones; though the fluid moves and acts as an intire body.*

TIS not my purpose here to insist on the efficacy of the motion of such fluid bodies as may have their motions discovered by the eye, like streaming water; or manifestly perceived by the touch, as are the winds that beat upon us: since 'twere needless to give Instances of such obvious things, as the great effects of overflowing waters and violent winds; the later of which, notwithstanding the great tenuity and soft-

even languid Local motion. 17

Softness of the air and the *Effluvia* that swim in it, have been sometimes able to blow down not onely timber-trees, but houses and steeples, and other the firmest Structures. But the motions I intend to speak of in this Chapter are such, as we do not immediately either see or feel; and though these be exceeding rare, yet the operation of *sounds*, even upon solid bodies, and that at a distance from the sonorous ones, afford me some Instances to my present purpose, which I shall now proceed to mention.

It has been frequently observed, that, upon the discharge of Ordnance and other great Guns, not onely the sound may be distinctly heard a great way off; but that, to a good distance, the tremulous motion of the Air that produces sound, without producing any sensible wind, has been able sensibly to shake; and sometimes violently to break, the glass-windows of houses and other buildings, especially when the windows stand in the way
C where

wherein the propagation of the sound is directly made. 'Tis true, that these observations are most frequent, when the place, where the Artillery is placed, stands upon the same piece of ground with the Houses whose windows are shaken; and so it may be suspected, that the Shake is first communicated by the Cannon to the earth or floor on which they play, and is afterwards by that propagated through the intermediate parts of the ground to the foundations of the houses, and so to the windows. And I readily grant, and may elsewhere shew, that a violent impulse upon the ground may reach to a greater distance than men usually imagine: But in our present Case I see no necessity of having recourse to any thing but the wave-like motion of the Air for the production of our Phenomenon, since the like may be produced by Local Motion transmitted by Fluids, as may appear by the following Instances.

I was once invited by an Engineer,
to

even languid Local motion. 19

to see triall made of a strange Instru-
ment he had to sink ships, though
great ones, in a few minutes; and
though an unlucky Accident kept
me from arriving there 'till near a
quarter of an hour after the triall had
been made on an old fregat, with bet-
ter successe than my Philanthropy
allowed me to wish; yet causing my
self to be rowed to the place, where
the great vessell was newly sunk;
the odness of the effect, which was
performed upon the water by a small
Instrument outwardly applied, made
me inquisitive, what noise and com-
motion had been made: And I was
informed partly by the Engineer him-
self, and partly by some acquaintances
of mine, who among a great number
of Spectators stood aloof off in ships
and other vessels lying at anchor, to
see the event; that, upon the En-
gine's operating, the explosion was
so great, that it made a kind of storm
in the water round about, and
did so rudely shake vessels that lay at
no inconsiderable distance, as to make

Of the great Effects of
those that stood on them to stagger.

In the late great Sea-fight between the English Fleet commanded by his Royal Highness the Duke of *York*, and the Dutch Admiral *Opdam*, (who therein lost the Victory and his Life,) though the Engagement were made very many Leagues from the *Hague*; yet the noise of the Guns not onely reached to that Place, but had a notable effect there; of which when I enquired of the English Embassadour that as yet resided there, he was pleased to assure me, that it shook the windows of his House so violently, that not knowing what the Cause was, he was surprized and much alarmed, apprehending, that some rude Fellows were about to break his windows to affront him. And if there be a greater disposition in some other bodies than there is in Glass-windows to receive strong impulses from the Air agitated by Sounds, these may be sensibly, though not visibly, wrought upon, and that at a good distance, by the noise of a single piece

piece of Ordnance ; as may appear by that memorable Circumstance of an odd Case about a Gangrene mentioned by the experienced *Simon Pauli* in his ingenious Tract de *Febribus malignis*, pag. 71. *Atqui ager ille Gallus brachio truncatus, octiduum quidem superfuit, sed horrendis totius corporis convulsionibus correptus; qui quoque, (ut & illa addam observatione dignissima,) dum in Domini sui adibus ad plateam Kiodmoggerianam, Romanè Laniorum appellares, decumberet, ac, me ac aliis aliquandiu ad Lectum illius confidentibus quidem, sed nobis non attendentibus, exploderentur tormenta bellica ex Regiis ac Prætoris navibus, sinistra truncum dextri brachii fovens ac complectens, toties quoties exploderentur singula exclamabat, Au, au, me miserum! Jesu, Maria, contundor penitus: adeò permolesta & intolerabilis illi erat Tormentorum explosio, & quidem ex loco satis longinquo, terrâ non firmâ aut contiguâ, verum super salo aut mari Balihico, instituta.* By this it appears, that the Guns, whose discharge pro-

duced these painfull motions in the Patient, rested upon a floating body. And I remember, that an illustrious Commander of a very great Man of war, being asked by me, whether of the many wounded men, he had in his ship in a very long Sea-fight, none of them were affected by that noise of the Enemy's Cannon discharged in ships at a distance? He answered me, that some, whose bones were broken, would sadly complain of the Torment they were put into by the shake they felt at the going off of the Enemy's Cannon, though they were too much accustomed to the report of great Guns, to be, as 'twas a bare noise, offended by it. If after all this it be surmized, that these motions were not conveyed by the air, but propagated by the water, (and, in some cases, some part of the shoar) from the ships, where the Guns were fired, to the Houses where the windows were shaken, or the places where the wounded men lay: I answer, that, if this could be made probable,

bable, it would accommodate me with very eminent Instances for the Chapter of the *Propagable* nature of Motion: And though it be very difficult to find such examples of shakes excited by sounds as are not liable to the mentioned objection; because the sonorous bodies here below do all either strike, or lean, upon such gross and visible bodies as the Earth and Water; yet there is one kind of Sound, that must be confessed to be propagated by the Air, as being made in it; and that is *Thunder*, whose noise does sometimes so vehemently affect the Air, though without producing any sensible wind, that both others and I have observed it very sensibly to shake great and strong Houses, notwithstanding the distance of the clouds where the noises were first produced. And I remember, that, having inquired of some Sea-Captains, that in stout vessels sailed to the *Indies*, whether they had nor in those hot Regions observed their ships, though very much less tall then

houses, to be shaken by vehement Thunders? I perceived, that some of them had not much heeded any such thing; but a couple of others told me, they had observed it in their ships; and one of them told me, that once, when the claps of thunder were extraordinary great, some of them shook his ship so rudely as to make the unwonted motions disorder his great Guns. All which I the less wonder at, when calling to mind, what I have mention'd in the foregoing Chapter and elsewhere of the power of the Celerity of motion, I consider, that there is no Celerity that we know of here below, that is near so great, as that wherewith a Sound is propagated through the air. For, whereas the diligent *Mersennus* observes, that a bullet shot out of a Cannon or a Musket does not overpass two hundred and forty yards in a Second, or sixtieth part of a minute; I have more than once diligently observed, that the motion of *sound* passes above four hundred yards in the same

even languid Local motion. 23

same time of a Second here in *England*; which I therefore add, because *Mersennus* relates, that in *France* he observed a Sound to move in that time many yards more; which may possibly proceed from the differing consistence of the English air and the French.

The great Loudness of these sounds, and the vehement percussion that the Air receives in their formation, will probably make it be easily granted, that 'twas onely the Impetuosity of the motion of the *Medium*, that gave the shake to the windows and other solid bodies that I have been mentioning to have been made to tremble by the report of Cannon or Thunder: But yet I will not on this occasion conceal, that perhaps it may without absurdity be suspected, that Some of those tremulous motions of solid bodies might either depend upon, or at least be promoted by, some peculiar disposition, that Glasse (which is endued with springiness,) and some other bodies that perhaps are not quite devoid of that Quality,
may

may have to be moved by certain congruous Sounds (if I may so call them) more than they would by others, though perchance more loud. But though this surmize should be admitted; yet it would not render the lately-recited Instances improper for the design of this Discourse, but onely would make some of them fit to be referred to another *Chapter*; to which I shall advance, as soon as I shall have annexed an odd Observation of the experienced *Platerus*, which argues, that, where there is a peculiar Disposition, even in a firm body, it may receive considerable impressions from so languid a motion (though in likelihood not peculiarly modified) of the air as is not sensible to other bodies of the same kind.

Plater. Observ. Fœmina quædam (says he) *Lib. I. p. 185. in subitaneum incidit morbum, viribus subito prostratis, se suffocari indefinenter clamitans, etsi nec stertoris nec tussis aliqua essent indicia; maxime verò de aura quædam adveniente, si vel leviter aliquis adstantium se moveret,*

even languid Local motion. 27

moveret, quæ illam opprimeret, conqueratur, seque suffocari, si quis propius accederet, clamitabat: vixdum biduum in ea anxietate perseverans, expiravit. To which he adds: *Vidi & alios agros, de simili aura, quæ eos, si quis illis appropinquaret, in suffocationis periculum induceret, conquerentes; quod semper pessimum esse signum apprehendi.*

CHAP. IV.

Observat. III. *Men undervalue the motions of bodies too small to be visible or sensible, notwithstanding their Numerousness, which inables them to act in Swarms.*

Most men, when they think at all of the *effluvia* of bodies and their motions, are wont to think of them as if they were but much finer sorts of Dust, (whose grains, by reason of their smallness, are invisible,) which, by the various agitation of the Air, are
as

as 'twere by some faint wind blown against the surfaces of the bodies they chance to meet in their way, and that they are stopped in their progress without penetrating into the interior parts of the bodies they invade. And according to this Notion, 'tis no wonder, that men should not fancy, that such minute bodies passing, as they suppose, no further than the surfaces of those on which they operate, should have but faint operations upon them.

But we may have other thoughts, if we well consider, that the Corpuscles we speak of, are, by their minuteness, assisted, and oftentimes by their figure inabled, to pierce into the innermost recesses of the body they invade, and distribute themselves to all, or at least to multitudes of the minute parts, whereof that body consists. For this being granted, though we suppose each single *effluvium* or particle to be very minute; yet, since we may suppose, even solid bodies to be made up of particles that are so too, and the number of invading particles

to

even languid Local motion. 29

to be not much inferior to that of the invaded ones, or at least to be exceedingly great, it need not seem incredible, that a multitude of little Corpuscles in motion (whose motion, may, for ought we know, be very swift) should be able to have a considerable operation upon particles either quiescent, or that have a motion too slow to be perceptible by sense. Which may perhaps be the better conceived by the help of this gross example :

If you turn an Ant-hill well stocked with Ants-eggs, upside down, you may sometimes see such a heap of eggs mingled with the loose earth, as a few of those Insects, if they were yoked together, would not be able at once to draw after them; but if good numbers of them disperse themselves and range up and down, and each lay hold of her own egge, and hurry it away, 'tis somewhat surprizing to see (as I have with pleasure done) how quickly the heap of eggs will be displaced, when almost every little egge has
one

30 Of the great Effects of
one of those little Insects to deal
with it.

And in those cases, wherein the invading Fluid does not quite disjoin and carry off any great number of the parts of the body it invades, its operation may be illustrated by that of the wind upon a tree in *Autumn*: for, it finds or makes it self multitudes of passages, for the most part crooked, not onely between the branches and twigs, but the leaves and fruits, and in its passing from the one side to the other of the tree, it does not onely variously bend the more flexible boughs and twigs, and perhaps make them grate upon one another, but it breaks off some of the stalks of the fruit, and makes them fall to the ground, and withall carries off divers of the leaves, that grew the least firmly on, and in its passage does by its differing parts act upon a multitude of leaves all at once, and variously alters their situation.

But to come to closer Instances:
sup-

even languid Local motion. 31

suppose we cast two lumps, the one of Sugar, the other of Amber, into a glass of beer or water, they will both fall presently to the bottom. And though perhaps the Amber may be lighter than the Sugar, (for, I have found a notable difference in the specific gravity of pieces of Amber,) yet the aqueous particles are far from being able to displace the Amber or any sensible part of it, or exercise any visible operation upon it: But the same minute particles of the liquor being of a figure that fits them to insinuate themselves every way into the pores of the Sugar, though the lump consisted of very numerous Saccharine Corpuscles, yet the multitude of the aqueous particles, to which they are accessible, is able in no long time to disperse them all, and carrying them along with themselves, make the whole lump of Sugar in a short time quite disappear.

The point above discoursed of, may be more nimbly exemplified in some Chymical operations, and particu-

ticularly in this. If, by a due degree of fire, you abstract from running Mercury four or five times its weight of good Oil of Vitriol, there will remain at the bottom a dry and brittle substance exceeding white; and, if upon this Heap of Mercurial and Saline bodies, which sometimes may be coherent enough, you pour a good quantity of limpid water, and shake them together, you may see in a trice the multitude of little white grains, that make up the masse, pervaded; and manifestly altered, by the dispersed Corpuscles of the water; as will plainly appear by the change of the *Calx* or *Precipitate* from a white masse into one of a fine Limon-colour.

But to give instances in Fluid bodies, (which I suppose you will think far the more difficult part of my task,) though you will easily grant, that the flame of Spirit of wine, that will burn all away, is but a visible aggregate of such *Effluvia* swiftly agitated, as without any sensible Heat
would

would of themselves invisibly exhale away; yet, if you be pleased to hold the blade of a knife, or a thin plate of Copper, but for a very few minutes, in the flame of pure Spirit of wine, you will quickly be able to discern by the great Heat, that is, the various and vehement agitation of the minute Corpuscles of the metal, what a number of them must have been fiercely agitated by the pervasion of the igneous particles, if we suppose, (what is highly probable,) that they did materially penetrate into the innermost parts of the metal; and whether we suppose this or no, it will, by our experiment, appear, that so fluid and yielding a body, as the flame of Spirit of wine, is able, almost in a trice, to act very powerfully upon the hardest metals.

The power of extremely minute parts of a fluid body, even when but in a moderate number they are determined to conspire to the same operation, may be estimated by the

D moti-

34 Of the great Effects of
motions of Animals, especially of the
larger and more bulky sorts, as Hor-
ses, Bulls, Rhinocerotus and Ele-
phants. For, though the animal
spirits be minute enough to be in-
visible, and to flow through such
tender passages, that prying Anato-
mists have not been able in dissected
Nerves to discern so much as the
channels through which they pass;
yet those Invisible Spirits, conveyed
(or impelled) from the Brain to the
Nerves, serve to move in various
manners the Limbs, and even the
unwieldy bodies themselves of the
greatest Animals, and to carry them
on in a progressive motion for many
hours together, and perhaps enable
them to spring into the Air, and move
through it by leaping; though di-
vers of these Animals weigh many
hundred, and others several thousand
of pounds.

I will not here consider, whether
the following Experiment may at all
illustrate Motions that are produced
by the fluid parts of Animals in some
of

of the consistent ones : But I presume, it may confirm the Observation maintained in this Chapter, if I add, what I have tried of the considerable force of a number of aqueous particles, as flexible and as languid as they are thought to be, insinuating themselves into the pores or Intervals of a rope that was not thick. For in moist weather I sometimes observed, that the aqueous and other humid particles, swimming in the air, entering the pores of the hemp in great numbers, were able to make it shrink, though a weight of fifty, sixty, or even more pounds of lead were tied at the end to hinder its contraction, as appeared by the weights visibly being raised in wet weather above the place it rested at in dry.

But to return to what I was formerly speaking of the Determination of the motion of Fluids; I shall, on this occasion, observe, that, though the wind or breath, that is blown out at a small crooked pipe of metal or glass, such as Tradesmen for its

use call a Blow-pipe, seems not to have any great celerity, especially in comparison of that of the parts of flame; and is it self of little force; yet, when by this wind the flame of a Lamp or Candle is directed so as to beat with its point upon a body held at a convenient distance from the side of the flame, the burning fluid, determined, and perhaps excited by this wind, acquires so great a force, that, as we have often tried, it may be made, in a few minutes, to melt not onely the more fusible Metals, but silver, or even copper it self; which yet may be kept for many hours unmelted in a Crucible kept red-hot, or even in the flame of the Lamp or Candle, unassisted by the blast.

And if we can so contrive it, that a flame does not come to invade onely the surface that invests a body, but comes to be intermingled with the smaller (though not the smallest) parts it consists of, as with its filings or its powder; the flame will then have a far more quick and powerfull

ope-

operation than the body exposed to it. This I exemplify (in other Papers) and in this place it may suffice to observe, that, whereas a pound or two of Tartar may cost you some hours to calcine it to whiteness, if the flame have immediate access onely to the outward parts; you may calcine it in a very small part of that time, if, mixing with its gross powder an equal weight of good Salt-peter, you fire the mixture, and keep it stirring, that the parts of the kindled Nitre may have access at once to very many parts of the Tartar, and have opportunity to calcine them. And by somewhat a like artifice, I elsewhere teach, how Nitre it self may without Tartar be speedily reduced to a *Calcinatum*, not unlike that newly mentioned. But it may be said, that some of the foregoing Instances (for it cannot be truly said of all) may indeed illustrate what we are discourfing of, but will not reach home to our purpose.

I shall therefore consider the

38 Of the great Effects of

Load-stone, which you acknowledge to act by the emission of Insensible particles. For, though Iron and Steel be solid and ponderous bodies, and Magnetical *effluvia* be corpuscles so very minute, that they readily get in at the pores of all kind of bodies, and even of Glass it self; yet these Magnetical *effluvia*, entring the steel in swarms, do in a trice pervade it, and a multitude even of Them, acting upon the Corpuscles of the metal, do operate so violently on them, that, if the *Load-stone* be vigorous enough, and well capped, it will attract a notable proportion of steel, and surmount the gravity of that solid metal, which I have found to exceed, when the stone has been very good and little, above fifty times the weight of the Magnet by whose *effluvia* it was supported: For, to these I rather ascribe Magnetical attraction and sustentation, than to the impulse or pressure of the ambient air, to which many Corpuscularians have recourse; because I have found by trial (which I else-

I elsewhere relate) that the pressure of the ambient air is not absolutely necessary to Magnetical operations.

I remember, that, to help some friends to conceive, how such extremely-minute particles as Magnetical *effluvia*, may, by pervading a hard and solid body, such as Iron, put its insensible Corpuscles into motion, and thereby range them in a new manner, I took filings of Steel or Iron freshly made, that the Magnetical virtue might not be diminished by any rust, and having laid them in a little heap upon a piece of paper held level, I applied to the lower side of the paper, just beneath the Heap, the pole of a vigorous Load-stone, whose Emissions traversing the paper, and diffusing themselves through the incumbent metall, did in a trice manifestly alter the appearance of the Heap; and, though each of the filings might probably contain a multitude of such small Martiall Corpuscles as Steel may be divided into by Oil of Vitriol or Spirit of Salt; yet the Mag-

netical *effluvia*, immediately pervading our metalline heap, did so remove a good part of the filings that composed it, as to produce many erected aggregates, each of which consisted of several filings placed one above another, and appearing like little needles, or rather like the ends of needles broken off at some distance from the point. And as these little temporary needles stood all of them erected (though more or less, according to their distance from the Pole of the Magnet) upon the flat paper; so they would, without losing their figure or connexion, be made as it were to run to and fro upon the paper, according as the Load-stone, that was held underneath it, was moved this way and that way; and as soon as that was taken quite away, all this little stand of pikes (if I may so call it) would (almost in the twinkling of an eye) relapse into a confused heap of filings.

There are two ways of explicating the turning of Water into Ice; one

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or other of which is approved almost by all the Corpuscularian Philosophers. The first is that of the *Cartesians*, who give an account of Glaciation by the recesses of the less subtile particles of the Etherial matter, without which the finer parts were too small and feeble to keep the Eel-like particles of water flexible, and in the form of a liquor. The *Atomists* on the other side ascribe the freezing of water to the ingress of multitudes of *frigorifick* Corpuscles, as they call them, which, entering the water in swarms, and dispersing themselves through it, crowd into the pores, and hinder the wonted motion of its parts, wedging themselves (if I may so speak) together with them into a compact body. But which soever of these two *Hypotheses* be pitched upon, the Phænomenon it self will afford me a notable Instance to my present purpose. For, the Particles of water, and much more the Corpuscles of cold, are confessed to be singly too small to be visible,

visible, and their motions are not said to be swift, but may rather be judged to be slow enough; and yet those minute aqueous, or more minute frigid particles, because of their number, produce in the glaciation of the liquour so forcible a motion outwards, as to make it break bottles, not onely of glass and earth strongly baked, but, as I have several times tried, of metal it self, that being full of the liquour were firmly stopped before the supervening of the Cold. And the expansive endeavour of freezing water is not onely capable of doing this, but of performing so much greater things, which I elsewhere relate, that my trials have made me sometimes doubt, whether we know any thing in nature, except kindled Gunpowder, that bulk for bulk moves more forcibly, though the motion seems to be very slow.

CHAP. V.

(Of the Propagable Nature of Motion.)

Observat. IV. *Men are not sufficiently aware, how propagable Local Motion is, even through differing Mediums, and Solid bodies.*

THere are four principal Occasions on which I have observed, that men are wont to think the Communicating of Motion much more difficult than indeed it is.

And *first*, there are many, that observing how usually those bodies that hit against hard ones rebound from them, easily perswade themselves, that Motion can scarce be transmitted or diffused through Solid bodies. But though it be true, that oftentimes in such cases the progressive motion of the body or the Solid,

Solid, that is struck or impelled, be either inconsiderable, or, perhaps, not so much as sensible; yet the impulse may make a considerable impression, and may be communicated to a great share of the particles of that matter, whereof the solid mass consists; as we see in the striking of a timber-beam at one end, the motion, though perhaps it were not strong at the first, may become sensible at the other. Though Bell-metal be so hard a body, that it is reckoned harder than iron it-self, insomuch that oftentimes it resists even files of Steel, which readily work on Iron; yet this solidity hinders not but that, as I have found, conveniently shaped vessels of Bell-metal, though thick, will be sensibly affected by a motion that neither is strong, nor touches them in more than a short line, or perhaps than a Physical point. The truth of this I have found by trial on more than one such vessels and particularly on one that was hemispherical, which being placed or held in a convenient posture,

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posture, if I did but gently pass the point of a pin for a little way along the brim of it, it would sensibly resound, and that (to a very attentive ear) so long, and in such a ringing manner, as made it highly probable, that the parts, immediately touched (and not so much as scratched) by the point of a pin, were not onely put into a vibrating motion themselves, but were enabled to communicate it to those that were next them, and they to those that were contiguous to them; and so the tremulous motion was propagated quite round the bell, and made divers successive Circulations before it quite ceased to be audible. And if, in stead of drawing a Line on the brim of the vessel, I struck it, though but faintly, with the point of a pin, though the part immediately touched would be but a physical point, yet the motion would be, like the former, propagated several times quite round; as was argued by the ringing and duration of the produced sound, though this metal-

metalline vessel were seven inches in Diameter, and of a considerable thickness. Nor was a solidity like that of Brass requisite to produce these effects. For I found them to insue much after the same manner, when I employed onely a short and slender thread of Glass, which though little, if at all, thicker than a pin, was yet hollow quite through. Now if it be true, as 'tis highly probable, that Sound, as it belongs to the air, consists in an undulating motion of the Air, and so in our case requires a vibrating motion in the sonorous body to impart that motion to the Air; we must grant in our Instances a wonderfull propagableness of motion, even when 'tis not violent, in Solid bodies themselves; since the point of a pin, gently striking a part, no bigger than it self, of a mass of very solid metal, could thereby communicate a sensible motion, and that several times circulated, to millions of parts equall to it in bulk, and much exceeding it in hardness. And since
the

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the effect was more considerable, when the trial was made in a much greater, than in a smaller vessel; 'tis probable, that, if I had had the opportunity of experimenting on a large and well-hung Bell, the *Phenomenon* would have been more notable; as it also seemed to be on our vessel, if, instead of striking it with the point of a pin, we cast, though but faintly, against the lower part of it a grain of shot, less than a small pins-head, or let a little grain fall, from about one foot high, upon the inside of the inverted Hemisphere. And to shew, that even soft and yielding bodies, and but faintly moved, are not to be excluded from a power of putting such hard ones into motion; I shall add, that I found almost the like effects to those above mentioned, by passing the pulp of my finger a little way along the lower part of the vessel. Nay, that fluid bodies themselves may communicate such an intestine and propagable motion, to harden solid ones, I may have hereafter

after an occasion to shew by the effects of a small Flame, and the Sun-beams on glass and steel. And I shall here on this occasion add this word about the Propagation of Motion produced in solid bodies by heat, that it much depends upon the particular Textures of the bodies. For I found, that when I heated a piece of glass or of a fire-stone, I could without inconvenience hold my naked hand upon parts that were very near (suppose within an inch off) the ignited portions of them. But, if we take a rod of Iron, for instance, and heat one end red-hot, the heat of that end will be so propagated towards the other, that it will offend one's hand at several times the distance, at which one might conveniently hold the rod, if it were of glass.

In many buildings it may be observed, (and is thought a sign of the firm Cohesion of their parts,) that a stamp of one's foot, nay or bare treading, or some such other lesse brisk impulse, made in one room, will

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will have a sensible effect in all or most of the others. And it often happens, that, by the hasty shutting of a door, the whole house is made to tremble; whence we may argue, that, even among solid bodies, motion made in one place may be readily propagated to many others: And if, as to the latter of the Instances, the sudden impulse and compression of the Air, made by the door supposed to be hastily shut, have any considerable share in the effect, the Phenomenon will serve to shew the efficacy even of such a motion of a fluid body, as we cannot directly feel upon divers large and firmly connected solid bodies.

In *Earthquakes* the tremulous motion sometimes extends so very far, that, though it seems highly probable, that the shake that is given to one part of the Earth by the firing and explosion of subterranean exhalations, (if that be the true and only cause of Earthquakes) is not capable of reaching near so far as divers

E Earth-

Earthquakes have done, but that the fire passes through some little subterranean clefts, or channels, or hidden conveyances, from one great Cavity or Mine to another; yet 'tis not improbable but that the vehemently tremulous motion does oftentimes reach a very great way beyond the places where the explosions were made. Since, though *Seneca* would

Natur. Quest. Lib.
VI. Cap. 25.

confine the extent of Earthquakes to two hundred miles, yet observations made in this and the last Century warrant us to allow them

a far greater spread. The Learned *Josephus Acosta* affirms,

Lib. III. Cap. 26. that in the Kingdom of *Pern*

in the year 1586 an Earthquake reached along the shoar of the Pacifick sea 160 Leagues; and adds, that sometimes it has in those parts run on from South to North 300 Leagues. And in the beginning of this our age (*Anno Dom. 1601*) good writers relate a much larger Earthquake to have happened, since it reached from

Asia

Asia to that Sea that washes the French Shoars, and, besides some Asiatick Regions, shook Hungary, Germany, Italy and France, and consequently a great part of Europe. And if that part of the Narrative be certain, which relates, that this lasted not much above a quarter of an hour, it will be the more likely, that this Earthquake shook great Tracts of Land beyond those places, to which the fired matter, passing from one cavity to another, could reach in so short a time: As you will the more easily guesse, if you try, as I have done, that in trains of Gunpowder it self the fire does not run on near so swiftly as one would imagine. But though I have been in more Earthquakes then one; yet, since they were too sudden and too short to afford me any considerable observation, I shall say no more of them; but proceed to take notice, that oftentimes the motion of a Coach or Cart, that passed at a good distance from the place that I was in, has made the

buildings so sensibly shake, that I could not but wonder, that so great a portion of so firm and sluggish a body, as the Earth, could, by a cause that seemed very disproportionate to such an effect, be made to tremble it self, and manifestly to shake firm buildings that were founded on it. And this observation made me the more inclinable to give credit to their Relations, who tell us, that in a calm night, the march of a troupe of horse may be felt, by attentive Scouts watching at a great distance off, by the shake that the ground receives from the trampling of the horses; though I formerly suspected much, and do yet a little, that the impulse of the air conveyed along the resisting surface of the ground, might mainly contribute to the effect that is ascribed onely to the motion of the soil.

Before I advance to the *Second* Member of this Chapter, it may not be impertinent to note, that in peculiarly disposed bodies, and especially in Organical ones, a very *languid* moti-

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motion may have a far greater effect, than it could produce by a bare propagation of it self. For it may so determine the motion of the Spirits or other active parts of the body it works on, as to make multitudes of them act as if they conspired to perform the same motions. As when a ticklish man, by having the pulp of one's finger passed gently along the sole of his foot or the palm of his hand, has divers muscles and other parts of his body and face put into preternatural or unusual motions. And most men by being lightly tickled with the end of a feather or straw, within their Nostrils, have their heads and many parts of their bodies put into that violent Commotion, wherein *Sneezing* consists. And I remember, that having for some time been, by a distemper, (from which God was graciously pleased a while after to free me,) quite deprived of the use of my hands; it more than once hapned to me, that sitting alone in a Coach, if the wind chanced to

E 3 blow

blow a single hair upon my face in the Summer-time, the tickling or itching, that it produced, was so uneasy to me, 'till by calling out to a footman I could get it removed, that, though I could well bear it as long as I was wont to do, when, having the use of my hands, I could relieve my self at pleasure; yet if I were forced to endure the itching too long, before any came to succour me, the uneasiness was so great, as to make me apprehend falling presently either into Convulsions or a Swoon. But 'tis time to proceed to the *second* Member of this Chapter.

2. Others there are, that cannot believe, that Local motion, especially if it be *languid*, can be propagated through differing Mediums, each of which, save that wherein the Motion is begun, must, they think, either repel, or check and dead it. To these I shall recommend the Consideration of an Experiment, I remember I made before some Learned men in our Pneumatick Engine. For, having

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caused a large and thick glass Receiver to be so blown, that it had a glass button in the inside of that part which upon the Engine was to be placed upwards; I caused a Watch to be suspended by a little Silver-chain fastned to that button by as slender and soft a body, as I thought would be strong enough to support my watch; and then, the Glass being cemented on close to the Receiver, to prevent a Commerce between the Cavity of it and the Air, the watch, that hung freely near the middle of the Cavity of the Receiver, made it self to be heard by those attentive Listners, that would hold their ears directly over the suspended watch, whose motions were thereby argued to have been propagated, either through the included air, or along the string to the concave part of the Glass, and through the whole thickness of the Glass to the convex part, and thence, through the interposed air to the Ear. And this mention of watches minds me of what I often ob-

E 4 served

served in a small striking watch, that I have worn in my pocket. For, when it struck the Hours, and in some postures when the balance did but move, I could plainly feel the brisker motions of the Bell, and sensibly the languid ones of the balance, through the several linings of my Breeches, and some other interposed soft and yielding bodies; and this, though the watch (as I said) was small, and the balance included in a double case, and though the outwardmost were of (what they call) Chagrine, and the innermost of Gold; which I therefore mention, because that closest of metals is observed more to dead sounds and motions than harder metals, as Silver, Copper, and Iron.

That Motion may be propagated through differing Mediums, may seem the more probable by the shakings that are often felt by men lying on beds that stand in rooms close shut, when loud claps of thunder are produced (perhaps at a great distance off) in the clouds. And whether it

will

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will be fit to add to this Instance that which you have lately met with in the III. Chapter of a wounded Frenchman at *Copenhagen*, I leave you to consider.

I know not whether it will be very proper to take notice on this occasion of an odd *Phenomenon* recited by the experienced *Agricola* De nat. eorum quæ effi. è Terra Lib. IV. Cap. 7. in these words. *Si animal dejicitur in antrum Vi-burgense, quod est in Carelia, Regione Scandiae, erumpit, ut perhibent, sonus intolerabilis magno cum flatu: Si leve pondus in specum Dalmatiae, quamvis, inquit Plinius, tranquillo die, turbini similis emicat procella.*

3. As those of whom I took notice at the beginning of this Chapter, are backward to allow, that Motion may be considerably propagated through *solid* bodies; so on the contrary, there are others that are indisposed to think, that 'tis near so propagable as indeed it is through *fluid* bodies; because they presume, that the easy cession of the parts of fluids

will

will dead the impulse received by those of them that are first acted on by the impelling body. And

4. There is yet another sort of Naturalists, who, though they may be brought to grant, that Motion may be propagated even through a soft and yielding Medium, cannot believe, that it should through such a Medium be propagated to any considerable distance; being perhaps induced to this opinion by observing, that, though a body somewhat broad as well as solid, as the Palm of one's hand or a battledore, be moved through the Air swiftly enough to make a wind; yet that wind will not be strong enough to be felt any more than a very little way off. Wherefore, because the Instances, to which I assign the remaining part of this Chapter, may be for the most part applicable to the removal of both these prejudices; It may for brevity sake be expedient to consider them both together.

If Luminous bodies act on our
Eyes,

Eyes, not by a substantial diffusion of extremely minute particles, as the *Atomists* would have it, but by a propagated Pulsion of some Subtile matter contiguous to the shining body, (as the *Cartesians* and many other Philosophers maintain;) 'twill be manifest, that a body less than a small pin's head may give a brisk motion to a portion of fluid matter many millions of times greater than it self; since in a dark night a single spark of fire may be seen in differing places, whose distance from it exceeds many thousand times the spark's *Diameter*. Not to mention the great remove, at which the flame of a small taper may not onely be seen, but appear greater than near at hand. And if we compare the *Diameter* of that bright Planet *Venus*, which yet shines but with a borrowed and reflected Light, with its *distance* from the Earth, we may easily conclude, that the fixed Stars, which probably are so many Suns that shine by their own native Light, must impell a stupendi-

pendious proportion of Etherial matter, to be able at that immense distance to make such vivid Impressions, as they do, upon our Eyes. But to descend to Instances less remote and disputable, I shall, in order to the removal of the two lately mentioned prejudices, proceed to consider; that, though it be true, that Fluid bodies do easily yield to Solid ones that impell them, and thereby oftentimes quickly dead the motion of those Solids; yet the motion, being lost onely in regard of the solid body, is not lost, but transmitted and diffused in reference to the fluid. As when a log of wood, or any such body specifically lighter than water, is let fall in the middle of a pond, though its progress downwards be checkt, and it be brought to rest quietly on the surface of the water; yet its motion is not lost, but communicated to the parts of the water it first strikes against, and by those to others, till at length the curls or waves produced on the surface of the water

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ter spread themselves, till they arrive at the brinks, and would perhaps be farther expanded, if these did not hinder their progress. From which instance we may learn, that, though the nature of fluid bodies, as such, requires, that their parts be actually distinct and separately moved; yet the particular Corpuscles that compose them, being (at least here below) touched by divers others, the new motion that is produced in some of them by an impellent Solid, must needs make them impell the contiguous Corpuscles, and these those that chance to lie next to them, and so the impulse may be propagated to a distance; which you will the more easily believe may be great, if you consider with me, both that in a fluid body the Corpuscles, being already in the various motion requisite to fluidity, yield more easily to the impellent, and also that being fully, or very near it, counterpoised by others of the same fluid, a scarce imaginably little force may suffice to impell them;

them; insomuch that, though the brass Scale of a balance, of divers inches in Diameter, may well be supposed to outweigh many myriads of such particles as compose water, wine, &c. yet, (as I elsewhere more fully relate) when such a scale was duly counterpoised with another like it, I could easily put it into various motions onely with the invisible *Effluvia* of no great piece of Amber. And if we consider that obvious Instance of the swelling Circles made by casting a stone into a Pond or other stagnant water, we shall be the more easily perswaded, that, even in a heavy fluid, a motion may reach a far greater way, than men are usually aware of, beyond the parts on which it was first imprest.

On this occasion I must not omit a strange Observation given me by a very experienced Navigator, that much frequents the Coast of *Groenland*, and other *Arctic* Regions, to fish for whales. For this person being discoursed with by me about the effects

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fects of the breaking of those vast piles of Ice, that are to be met with in those parts, assured me, that not onely he had often heard the Ice make in breaking terribler noise than the loudest claps of thunder with us, but that sometimes, when the Sea-water had, as it were, undermined the foundation of the mountainous piece of Ice, he has known it at length suddenly fall into the subjacent Sea with so much violence as to make a storm at a great distance off; inso-much that once, when he lay two Leagues off of the place where this stupendious mass of Ice fell, it made the waves goe so high as to wash clear over the stern of the ship, with danger enough to some of his men, and to sink several of his shallops that were riding by, though scarce any small vessels in the world use to be so fitted for rough Seas as those about *Groenland*.

And whereas, though the Air be a much thinner fluid, we are apt to think it indisposed to propagate motion

tion far, give me leave to tell you, that we may take wrong measures, if we think, that, (for instance) the undulating motion, into which the Air is put by the action of sonorous bodies, reaches but a little way, as we are apt to presume it does, because we judge of it by the effect it has on our ears when the sound is made in disadvantageous places. For one, that, for instance, hears a Lute or a Viol plaid on in a room furnished with hangings, will be apt to think the sound faint and languid in comparison of what it would appear to him, if the same Instrument were plaid on after the same manner in an arched room without hangings; these soft and yielding bodies being apt to dead the sound, which the figure and hardness of the Vaulted room would reflect. And so, when a man speaks aloud in the free Air, we are not wont to take any notice of a progress made by the motion of the Air beyond the place we are in, when our ears receive the sound; but if the place happen

to

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to be furnished with an *Echo*, though at many times that distance from the speaker, we may then easily take notice, that the motion of the Air was carried on, and that with good vigour, to a far greater distance than else we should have observed. And I have often thought, that, even by the better sort of our Echoing places, we are not informed, to near how great a sphere the motion, which the Air is put into by Sounds, may extend it self, where its diffusion and vigour are not hindred nor weakned by bodies either placed too near, or indisposed to promote its operation.

What has been lately said of the great diffusion of Sounds, if themselves be loud and great, will appear highly probable, by what is related by the Learned *Fromundus*,

who being Professour of *From. Meteor.*
Lib. II. Art. 9.
Philosophy at *Lovain*, in

the Year 1627, had opportunity enough to know the Truth of what he relates; namely that, at the famous Siege of *Ostend* in *Flanders*, the

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thunder of the great Ordnance was heard at above thirty Dutch Leagues, which, according to the vulgar reckoning, amounts to a hundred and twenty of our English miles. And that is yet, as he truly observes, more strange, and makes more for our present purpose, which he adds concerning the diffusion of the sound of a Drum, which, he says, was, upon a time, heard at Sea twelve Leagues off.

But to return to what I was saying of *Echo's*, to confirm my conjecture about them, I shall think it needlesse to offer you any other Argument, than that which you will draw your self from the Notable Relation I met

with in the Learned *Va-*
Geograph. general. *renius* of an Observation
Lib. I. Cap. XIX. made by *David Frelich-*

us, who, in the Company of a couple of Students, had the curiosity (in the month of *June*) to visit the mountain *Carpathus*, esteemed the highest of all the *Hungarian Hills*, and said to be much more steep and difficultly ac-
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cessible than any of the *Alps* themselves. *Frélichius* then (in my Author's) having related with what difficulty he and his Companions ascended above that Region of the Air, where they met with clouds and vehement winds, adds this memorable Observation, for whose sake I mention the story : *Explosi* (saies he) *in ea summitate sclopetum, quod non majorem sonitum primò præ se tulit, quàm si tigillum vel bacillum confregissem ; post intervallum autem temporis murmur prolixum invaluit, inferiorésque montis partes, convalles, & sylvas oplevit. Descendendo per nives annosas intra convalles, cùm iterum sclopetum exonerarem, major & horribilior fragor quàm ex tormento capacissimo inde exoriebatur : hinc verebar, nè totus mons concussus mecum corrueret ; duravitque hic sonus per semiquadrantem horæ, usque dum abstrusissimas cavernas penetrasset, ad quas Aer undique multiplicatus refluit. Et talia quidem objecta concava in summitate se non illico offerebant, idcirco ferè insensibiliter*

primum sonus reperiiebatur, donec descendendo antris & convallibus vicinior factus, ad eas fortius impegit.

CHAP. VI.

Observat. V. Men usually think not what the modification of the invisible motion of Fluids may perform on the disposed bodies of Animals.

IN this Observation I expressly mention the disposed bodies of Animals, to intimate, that there is a peculiar aptitude required in those Animals, or some particular parts of them that are to be sensibly affected by such motions as we are treating of, which would otherwise be too languid to have any sensible operation on them.

It seems the less strange to me, that continuing Sounds, and other somewhat durable Impulses of the Air or other Fluids, should have a manifest operation upon Solid bodies, when I consider

der the multitude of strokes that may in a very short and perhaps scarce observable time, be supposed to be given by the parts of the fluid to the Consistent body. For, though each of these single would perhaps be too languid to have any sensible effect at all; it being opportunely and frequently repeated by the successive parts of the fluid, as by so many little swimming hammers or flying bullets, they may well have a notable effect upon the parts of a body exposed to their action: As may be argued from the great swing that may be given to Pendulums by a very languid force, if it successively strike the swinging body, when having finished its excursion, 'tis ready to return towards the Perpendicular; as also from the tremulous motion that is imparted even to the metalline string of a Musical Instrument, by the congruous motion the Air is put into by another trembling string, (as there may be hereafter occasion to declare.)

I remember, *Scaliger* tells a plea-

fant story of a Knight of *Gascony*, whom the sound of a Bagpipe would force presently to make water ; adding, that a Person disoblighd by this man, and resolving to be merrily revenged on him, watched a time when he sate at a Feast so as he could not well get out, and brought a Bagpiper to play unawares behind him ; which he did so unluckily, that the Musick had presently its wonted effect upon the poor Knight, to his great Confusion and the laughter of the Company. On which occasion I shall add, that I know a very Ingenious Gentleman, who has confessed to me, that the noise of a running Tap is wont to have almost the like operation upon Him.

'Tis a common Observation, that the noise that an ungreased cart-wheel makes in grating against the axel-tree, and the scraping of a knife upon a plate of silver or pewter, and some other such brisk and acute Sounds, do so affect divers parts of the Head, as to produce that effect
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that is commonly called *setting the Teeth on edge*; which whether it proceed from any commerce between the Auditory Nerves, and those that are inservient to the motion we have mentioned, I leave Anatomists to consider. But these effects of acute sounds are much less considerable than that which I elsewhere relate of an Ingenious Domestick of mine, who several times complained, that the tearing of brown paper made his Gums bleed: which argued that the sound had an operation not onely upon the nervous and membranous parts, but the blood and Humours themselves.

Sir Henry Blunt, in his voiage to the *Levant*, giving an account of what he observed in *Egypt*, has, among other remarkable things, this passage: Many rarities of Living creatures I saw in *Gran Cairo*, but the most ingenious was a nest of four-legged Serpents of two foot long, black and ugly, kept by a Frenchman, who when he came to handle them, they would not endure him, but ran and hid

in their hole ; then would he take his Cittern and play upon it : They, hearing his Musick, came all crawling to his feet, and began to climbe up him, till he gave over playing, then away they ran.

This recalls to my mind, what some men of repute, and particularly the Learned *Kircherus*, relate concerning a great Fish, in or about the Streights that sever *Sicily* from *Italy*, which is said to be much affected with a peculiar kind of Tune, (harsh enough to Humane ears) by which the Mariners are wont to allure it to follow their vessels. And it may much strengthen the Conclusion maintained in this Chapter, if there be any certainty in the famous tradition, that the Lion is terrified and made to run away by the crowing of a Cock : I say, *if*, because though I doubt not but some peculiar kinds of Sounds, as well as of other sensible objects, may be particularly and exceedingly ungratefull to the Sensories of this or that peculiar kind of Animals, and consequently

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to the ears of Lions; yet a late French Traveller into the *Levant* gives me cause much to question the matter of fact, affirming, that rowing along the brink of *Tigris* or *Euphrates*, (for I do not punctually remember which,) they were, for many hours in the night, terrified by Lions that attended them along the brink of the River, and would not at all be frighted by the frequent crowing of the Cocks that chanced to be in the passengers Boat. Of which unconcernedness of the Lions, our observing traveller took much more notice than the Lions appeared to do of the crowing of the Cocks. I might on this occasion say something of the received Tradition, that many sleeping persons will be more easily waked by being called upon by their own usual names, than by other names, though uttered with a louder voice. But this it may suffice to have mentioned; nor will I here insist on that more certain example of the operation of a Sound, which is as-
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forded by the starting of men or greater Animals, upon a surprizing, though not vehement, noise; though this oftentimes puts so many of the Spirits and Muscles into motion, that the whole bulk of the Animal is suddenly raised from the ground, which perhaps it could not be by the bare counterpoise of some hundreds of pounds: This, I say, I will not in this place insist on, because the *Phenomenon* seems to depend rather upon the loudness or acuteness of the sound, than upon any determinate modification of it, particularly relating to the *Animal* it self.

But the eminentest Instance of the efficacy of peculiarly modified Sounds upon disposed bodies, is afforded by what happens to those which are bit by a *Tarantula*. For though the bitten person will calmly hear divers other tunes, yet when a peculiarly congruous one comes to be plaid, it will set him a dancing with so much vigour as the spectators cannot but wonder at, and the dancing will
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sometimes continue many hours, if the Musick do so, and not otherwise. I know there are some that question the truth of the things related of these *Tarantati*, (as the *Italians* call them,) and I easily grant, that some Fictions may have been suffered to pass under the countenance of so strange a Truth. But besides the affirmations of some Learned men, (as well Physicians as others) my Doubts have been much removed by the Accounts I have received from an Ingenious Acquaintance of mine own, who at *Tarentum* it self, whence the Insect takes its name, and elsewhere, saw many bitten persons in their dances, some in publick and some in private places, and amongst the rest a Physician, on whom the tune that fitted his distemper had the same operation as on the other Patients. And the Learned *Epiphanius Ferdinandus*, who practised Physick in *Apulia* and *Calabria* for many years, not onely delivers upon his own personal observation, several Narratives of the effects

effects of Musick upon the *Tarantati*, but invites any that may doubt of the truth of such Narratives to repair to him at a fit season, undertaking to convince them by ocular Demonstration.

I know a very honest and sober Musician, who has divers times affirmed to me, that he could at pleasure, by playing a certain Tune, (which he acquainted me with, and which did not much move others) make a person (whom he named to me) weep, whether she would or no. And I might add, that when I have been taking Physick, or am any thing feverish, the repetition of two verses of *Lucan* seldom fails (as I have often tried) of producing in me a chilness, almost like that, but fainter, that begins the fit of an ague. But on this Instance I look not as a strong proof of the Physical efficacy of Sounds; because those two verses having been emphatically read, when divers years agoe I lay sick of a slow fever, and could not rest, they made
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so strong an impression on me, that whenever I am under a Discomposure any thing near like that, that then troubled me, those verses revive, as 'twere, in my brain and some other parts that disposition, or rather indisposition, with which my first hearing of those verses was accompanied.

It may be the less admired, that the vibrating motion of the Air, that produces sounds, should have such effects upon disposed Organical bodies, since Light it self, which either consists of briskly moving *effluvia* far more subtile than aerial corpuscles, or is propagated by the pulse of a far more subtile body than Air, may have a notable operation upon disposed bodies. For we commonly observe, that the Sunbeams, by beating upon the face or eyes of some that come suddenly out of a shaded place into the Light, presently make them sneeze; which you know is not done without a vehement motion of divers parts of
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the body. And though Colour be but a modification of Light; yet, besides that 'twas anciently a practice, as the History of the *Macchabees* informs us, to shew red objects to Elephants, to make them more fierce, 'tis a familiar observation, that red cloaths do offend and irritate Turkey-cocks. And that is more remarkable, which is related by the very Learned Physician *Valesius*, of a person that he knew, who, if he looked upon red objects, would not onely have his Eyes offended, but was subject to an effusion of Humours in the neighboring parts:

CHAP. VII.

Observat. VI. *Men suspect not what efficacy the Invisible motions of Fluids may have, even upon inorganic bodies, upon the score of some determinate Congruity or relation betwixt a peculiar Texture of the one, and the peculiar modification of the others motion.*

THough the Experiments delivered in the foregoing Chapter have, I presume, sufficiently manifested, that the modification given to the motions of the Air by sonorous bodies may have considerable effects upon Animals, in whose organized bodies the curiously contrived parts have an admirable connexion with, and relation to, one another, and to the whole Symmetrical fabrick they make up; yet, I fear, it will scarce seem credible, that sonorous motions of the Air, not very loud, should find, even in
bodies

bodies Inanimate and Inorganically, such congruous Textures and other Dispositions to admit their action, that even more languid Sounds, peculiarly modified, may sensibly operate upon them, and much more than sounds that are louder and more vehement, but not so happily modified. To make this good by particular Experiments, I shall begin with that, which, though the effect may seem inferior to that of most of the others, I judge fittest to manifest, that the produced motion depends upon the determinate modification of that of the impellent Fluid.

That a certain impulse of Air, made by one of the Unison-strings of a Musical Instrument, may suffice to produce a visible motion in another, is now become a known experiment; of the Cause and some unobserved Phenomena of which I elsewhere more fully discourse. But, that it may not be suspected in this case, that the shake of the untouched string is communicated to it by the

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propagated motion of the Instrument it self, to which the string, that is struck, is also fastned; I shall add, that, according to what I elsewhere relate, I found by trial purposely made, that a string of Wire, (which you will grant to be a more solid body than an ordinary Gut-string,) may be without another string brought to tremble by a determinate Sound made at a distance, which produced but such an impulse of the Air, as could neither be seen nor felt by the By-standers, nor would communicate any sensible motion to the neighbouring strings. 'Tis true, that in this case the string, in which the trembling was produced, was a single, long, slender and springy body, fastned at both ends to a stable one; and therefore it may seem altogether groundless to expect, that any thing like this effect should be by the same cause produced in bodies that do not appear so qualified. But, as we elsewhere shew, that a certain degree or measure of tension is in order

der to this Phenomenon the principal Qualification, without which all the other would be unavailable; perhaps 'twill not be absurd to enquire, *whether*, in bodies of a very differing appearance from strings, the various Textures, Connexions, and Complications; that Nature or Art, or both, may make of the parts, may not bring them to a state equivalent to the Tensions of the strings of Musical Instruments, whereby divers of the mentioned parts may be stretched in the manner requisite to dispose them to receive a vibrating motion from some peculiar Sounds: And *whether* these trembling parts may not be numerous enough to affect their neighbours, and make, in the body they belong to, a tremulous motion discernible, though not by the Eye, yet by some other sense. This conjecture or inquiry you will, I hope, have the less unfavourable thoughts of, when you shall have considered the following Experiments.

I remember, that many years agoe
I found

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I found by trial, that, if a somewhat large and almost hemispherical Glasse, though not very thin, were conveniently placed, a determinate sound, made at a convenient distance from the concave surface of the Glasse, would make it sensibly ring, as a Bell does a while after it has been struck. But this noise was the effect of a determinate sound; for, though the voice were raised to a higher tone, or if the sound were made louder, the same effect would not insue. I remember also, that, some years after, I observed, that large empty drinking-glasses of fine white metal had each of them its determinate Tension, or some disposition that was equivalent as to our purpose. For, causing the strings of a Musical Instrument to be variously screwed up, and let down, and briskly struck, we found, as I expected, that the motion of one string, when 'twas stretched to a certain note or tone, would make one of the Glasses ring, and not the other; nor would the sound of the

same string, tuned to another note, sensibly affect the first Glasse, though perhaps it might have its operation upon another. And this Circumstance is not, on this occasion, to be omitted, that, after we had found the tone proper to one of the Glasses, and so tuned the string, that, (I say) when that was struck, the Glasse would resound. Having afterwards broken off a part of the foot of the glass, yet not so much but that it continued to stand upright, the same sound of the string would no longer be answered by the Vessel, but we were obliged to alter the tension of the string, to produce the former effect. The Learned *Kircherus*, as I have been informed, somewhere mentions a correspondence between some liquours and some determinate sounds; which I suppose may be true, though the triall did not succeed with me, perhaps for want of such accommodations for so nice an Experiment as I could have wished, but could not procure: But if you can, you will oblige

lige me to make the trials so as to satisfie your self and me, whether the agitation of the liquour be caused immediately by the motion of the Air, or be communicated by the intervention of the tremblings of the Vessel.

An Artist famous for his skill in making Organs, answered me, that, at some stops of the Organs, some seats in the Church would tremble. But, because I suspected by his Relation, that the greatness of the sound chiefly effected it, because, when that Pipe, which they call the open *Diapason*, sounds, the chair or seat, on which the Organist sits, and perhaps the neighbouring part of the Organ trembles; I shall add, that I have divers times observed certain sounds of an excellent Organ to make not onely the seat, I sate on in the Church, tremble under me, but produce an odd tremulous motion in the upper part of my Hat, that I could plainly feel with my hands. And that, which makes me apt to believe that this effect depends upon the de-

terminate tone, rather than upon the loudness of the sound, is, that I have oftentimes felt, and diligently observed such a kind of motion in the upper part of my Hat, upon the pronouncing of some words in ordinary discourse; in which case the effect could not with probability be referred to the greatness of the Sound, but its peculiar fitness to communicate such a motion to a body so disposed.

Nor is it onely in such small and yielding bodies, as Hats and Strings, that Sounds that are not boisterous may produce sensible effects, for, if they be congruous to the Texture of the body they are to work on, they may excite motions in it, though it be either solid or very bulky: of which I shall here subjoyn a couple of instances.

An ancient Musician affirmed to me, that, playing on a Base-viol in the chamber of one of his Scholars, when he came to strike a certain Note on a particular string, he heard an odd kind of jarring Noise, which he
thought

thought at first had either been casual, or proceeded from some fault in the string; but, having afterwards frequent occasion to play in that same room, he plainly found, that the Noise, he marvelled at, was made by the tremulous motion of a Casement of a window, which would be made to tremble by a determinate sound of a particular string, and not by other Notes, whether higher or lower.

To this first Instance I shall add the second, which, I confesse, I was not forward to believe, till trial had convinced me of the Truth; and I scrupled it the rather, because, if the reflexion of determinate Sounds should appear to proceed from the peculiar kind of tremulous motion into which the parts of the resonant body are put, it may incline men to so great a Paradox, as to think, that such a motion of the Air as our Bodies do not feel, may produce a trembling in so solid a body as a Stone-wall of a great thickness. The Experiment or Observation it self I shall give you

in the same words I set it down some hours after I made it, which were these.

Yesterday I went to satisfy my self of the truth of what had been told me by an ancient Musician, to whom I had been relating what I had observed of the effects of some determinate Sounds even upon Solid bodies, and of whom I enquired, if he had met with any thing of the like nature: taking him along with me, I found, that though the place be but an Arch, yet it would not answer to all notes indifferently, when we stood in a certain place, but to a determinate Note, (which he afterwards told me was *Ce fa ut* a little flatted,) to which note it answered very resonantly, and not sensibly to others, which we made trial of, whether higher or lower than it; and, (which added to the strangeness,) when I made him raise his voice to an Eighth, as consonant as those two Sounds are wont to be in all other cases, the vaulted Arch did not appear

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pear to us affected with the Note. The Musician added, that he had tried in most Arches all about the City, and could not find such a peculiarity in them, as being to be made resonant by all Notes or Sounds indifferently that were strong enough; and also, that as this Arch for this hundred years has been observed to have this property, so an ancient and experienced Builder informed him, that any Vault that were exquisitely built, would peculiarly answer to some determinate Note or other.

CHAP.

CHAP. VIII.

Observat. VII. *Men look upon divers Bodies as having their parts in a state of absolute Rest, when indeed they are in a Forced state, as of Tension, Compression, &c.*

THis Observation will probably seem paradoxical. For, when an intire Body, especially if it be of a solid Consistence, and seem to be of an homogeneous or uniform matter, appears to be movelesse, we are wont to take it for granted, that the parts, which that body is made up of, are perfectly at Rest also. But yet this will scarce be thought a reasonable supposition, if we do but rightly consider some obvious *Phenomena*, which may teach us, that, whilst a whole Body, or the superficies that includes it, retains its figure, dimensions and distance from other stable Bodies that are near it, the Corpuscles that compose it may have various

various and brisk motions and endeavours among themselves. As, when a bar of iron or silver, having been well hammered, is newly taken off of the Anvill; though the Eye can discern no motion in it, yet the touch will readily perceive it to be very hot, and, if you spit upon it, the brisk agitation of the insensible parts will become visible in that which they will produce in the liquour. Besides, when the Lath of a Cross-bow stands bent, though a man do neither by the Eye nor the Touch perceive any motion in the springy parts, yet if the string be cut or broken, the sudden and vehement motion of the Lath, tending to restore it to the figure it had before it was bent, discovers a springiness; whence we conclude it was before in a state of violent Compression. And, though the string of a bent Bow do likewise appear to be in a state of Rest; yet, if you cut it asunder, the newly made extreams will fly from one another suddenly and forcibly enough to

to manifest, that they were before in a violent state of Tension. And on this occasion I could add divers Instances taken not onely from the works of Art, but those of Nature too, if they did not belong to another paper: But, one sort of Observations 'twill be proper to set down in this place; because in those already mentioned, the bow and string were brought into a violent state by the meer and immediate force of man. I shall therefore add, that there are divers bodies, in which, though no such kind of force appears to have antecedently acted on them, we may yet take notice of a state of violent Compression or Extension, and a strong endeavour or tendency of the parts, that to the Eye or the Touch seem at rest, to shrink or to fly out; and this endeavour may in some Cases be more lasting and more forcible than one would easily suspect or believe. But examples of this kind you must not expect that I should give you out of *Classick* Authors,

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hours, since in them 'tis like you have not met with either an Instance or a Conjecture to this purpose ; but some few things that I tried my self, and some others that I learnt by Inquiry from some Tradesmen , whom I judged likeliest to inform me , I shall briefly acquaint you with.

I have sometimes observed my self, and have had the Observation confirmed to me by the ingenious Traders in Glass; That a Glass, that seemed to have been well baked, or nealed,(as they call it)would sometimes, many days or weeks, or perhaps months, after it is taken from the fire, crack of its own accord ; which seems for the most part to happen upon the score of the strong, but unequal, shrinking of the parts of the Glasse. And the Glass-men will tell you, that, if they take their Glasses too hastily from the fire, not allowing them leisure to cool by degrees, they will be very apt to crack. But I remember, that, to satisfy some Ingenious

genious men, I devised a way of exhibiting a much more quick and remarkable *Phenomenon* of that kind. Having made then, by a way I elsewhere teach, a flat Lump of metal-line Glass, two or three or four times as thick as an ordinary Drinking-glass, I observed, as I expected, that, though it had been melted in a very gentle fire, its very fusible nature needing no other, and though it were removed but very little from the fire, it was so disposed to shrink upon a small degree of Refrigeration, or rather abatement of Heat, that, before it was sensibly cold, it would crack with a noise in so vehement a manner, that, notwithstanding the ponderousness of the matter, which had been purposely laid upon a Level, parts of a considerable bulk, weighing perhaps some Drams, would fly, to a not inconsiderable distance from one another. And this Experiment I took pleasure to make more than once. And if you will be content with an Instance which,

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which, though otherwise much inferior, may not be unwelcome, for its being easily and readily made; I shall offer you one that I have often repeated. Take a piece of Copper, (if the Plate be thick, 'tis so much the better,) and, having thoroughly brought it to a red or white Heat among kindled Coals, take it from the fire, and when it begins to cool a little, hold it over a sheet or two of white Paper, and you will perceive good store of flakes to fly off, not without some little noise, one after the other, and sometimes perhaps as far as the farthest edges of the paper; which flakes or scales seem by their brittleness and colour, to be but parts of the surface of the metal vitrified by the vehement action of the fire, and afterwards by a too hasty refrigeration shrinking so violently, as to crack and leap from one another, like the contiguous parts of the string of a Viol or other Musical Instrument, that breaks by the moisture of the Air. And on this

this occasion I shall add, that, having afterwards inquired of an expert Artificer, that made metalline Concaves, about the shrinking of his mixtures of metalls, he confessed to me, that he usually observed them to shrink upon Refrigeration. And the like I my self have observed in Iron of a great thickness, and purposely fitted to a hollow body of metall, which it would not enter when it was ignited, though it would when 'twas cold. But to shew you by a notable Instance or two, both that Metals may shrink, and that they may doe so with a very considerable force, I shall add, that I found by inquiry, that the lately mentioned Artificer, after he had made some large Concaves of an unfit mixture of metals, and having removed them from the fire, had been very carefull to keep the cold Air from them, lest they should cool too hastily, observed yet to his great loss, that, when they came to be further refrigerated, they would (perhaps after three hours) crack with a great noise, though

though this metalline mixture were perchance harder than Iron, and three or four times as thick as common Looking-glasses. But the misfortune of another Tradesman afforded me a yet more considerable *Phenomenon*. For this excellent Artificer, whom I often employ, and with whom I was a while since discoursing of these matters, complain'd to me, that, having lately cast a kind of Bell-metall upon a very strong solid Instrument of Iron of a considerable superficial *Area*, though the metal were suffer'd in a warm room to cool, from about eight a clock on Saturday night till about ten or twelve on Monday morning, and were then (which is to be noted) considerably hot to the touch; yet it cool'd so far, that, shrinking from the Iron that would not shrink with it, the Bell-metall cracked in divers places with noises loud as the Report of a Pistoll, though the metall, he affirm'd to me, was an inch and half, or two inches thick. And the same

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person shewed me a large Cylinder of Iron, about which, for a certain purpose, a Coat of Bell-metall had been cast some days before, on which (Bell-metall) there was a crack near one end made by the coldness of the Iron, though the thickness of the Bell-metall, as near as I could measure it, exceeded an inch, and (as the Workman affirmed) an inch and a quarter.

Nor is it onely in such mixtures as Bell-metall, which, though very hard, may be very brittle, but even in a metal that is malleable when cold, that the like Phænomenon may be met with, as I have been assured by another ingenious Artificer, of whom I inquired, whether he had taken notice of the shrinking of metalls; who affirm'd to me, that, having had occasion to cast about a Cylinder of Iron a ring or hoop of Brass, he found to his trouble, that, when the metall began to cool, the parts shrunk from one another so as to leave a gaping crack, which he was fain to fill

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fill up with soulder quite crosse the breadth of the ring, though this were above an inch thick.

I should not, *Pyrophilus*, have in this Chapter entertained you with more Experiments of others than of my own, if I had the conveniency of living near Founders of metall's, as the Tradesmen had whose Observations I have recited, and whose sincerity in them I had no cause to question. And both their Experiments and mine seem to teach, that a body may be brought into a state of Tension, as well by being expanded and stretch'd by the action of the fire upon the minute parts, as by the action of an external Agent upon the intire body. And, to speak more generally, the state of violent Contraction and Compression may not unfitly be illustrated by a Bow that is bent. For, as the Bow it self is brought to a state of Compression by the force of the Archer, that bent it; so by the Elastical force of the bent Bow, the string is brought into a violent state

of Tension, as may be made evident by the cutting off the string in the middle; for then both the Bow will fly suddenly outwards, and the parts of the string will swiftly and violently shrink from one another. And according to this Doctrine, the effect of other bodies upon such as are thus brought into, what men call, a Preternatural state, is not to be judg'd barely according to usual measures, but with respect to this latent Disposition of the Patient: as, for instance, though the string of a Viol not screw'd up, will not be hardned by the vapours that imbue the Air in moist weather; yet a neighbouring string of the same Instrument, though perhaps much stronger, being screw'd up, and thereby stretched, will be so affected with those vapours, as to break with noise and violence. And so, when one part of a piece of Glass is made as hot as can be, without appearing discolour'd to the Eye, though a drop or two of cold water have no effect upon the other part of

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the same Glasse, yet if it touch the heated part, whose wonted extension (as I have elsewhere proved) is alter'd by the fire that vehemently agitates the component particles, the cracking of the Glasse will almost always presently ensue.

If against these Instances it be alledged, that it is possible to assign another cause of the seemingly spontaneous breaking of the bodies mention'd in this Chapter, than that which I have propos'd, it will not much concern this Discourse to examine the Allegation; for, whatever the latent Cause of the Phanomena may be, the manifest Circumstances of them suffice to shew, that bodies, which, as to sense, are in a natural state of Rest, may be in a violent one, as of Tension, and may have, either upon the score of the texture of the parts among themselves, or upon that of some interfluent subtile matter, or some other Physical Agent, a strong endeavour to fly off or recede from one another; and that,

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in divers bodies, the cause of this endeavour may act more vigorously than one would easily believe: and this suffices to serve the turn of this Discourse. For I presume that a person of your Principles will allow, that Local Motion must be produc'd by Local Motion, and consequently, that, without a very strong, though invisible and unheeded one, such hard and solid bodies as thick pieces of metall could not be made to crack.

I know not whether I may on this occasion acquaint you with an odd Relation I had from a very honest and credible, as well as experienced, Artist, whom I, for those reasons, have several times made choice to deal with about precious Stones, and other things belonging to the Jewelers and Goldsmiths trades. For, considering with him one day a large lump of matter, which contained several Stones that he took for course Agats, and which were joyned together by a Cement, that in most places was harder than most ordinary

ry Stones, I perceived that there remained divers pretty large cavities in this Cement, which seemed to have contained such Stones as those that yet made parts of the lump. Upon which occasion he affirmed to me, that several of the Stones grew whilst they were lodg'd in those cavities. And when I told him, that, though I had been long of an opinion, that Stones may receive an increment after their first formation, yet I did not see how any such thing appeared by those we were looking upon: He gave me in many words an account of his Assertion, which I reduced to this, that the Stones he spoke of, did, after they were first formed, really tend to expand themselves by virtue of some Principle of growth, which he could not intelligibly describe; but that these Stones being lodg'd in a Cement extreamly hard, and therefore not capable of being forced to give way, their expansive endeavour was rendered ineffectual, but not destroyed: so that when afterwards these

Stones came to be taken out of the Cement wherein they were bedded, and to whose sides 'tis like they were not exquisitely congruous, the compressed Stones, having their sides now no longer wedged in by the harder Cement, quickly expanded themselves, as if 'twere by an internal and violently compressed spring, and would presently burst asunder, some into two, and some into more pieces; of which he presented many to his friends, but yet had reserved some, whereof he presented me one, that I have yet by me, together with some of the mass, whose Cement I find to bear a better polish than marble, and to be very much harder than it. And, in answer to some questions of mine, he told me, that he had taken up these Stones himself, naming the place to me, which was not very far off, and that he observed all that he told me himself, and more than once or twice, and that I needed not suspect, as I seemed to doe, that 'twas the strokes employed to force the
Stones

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Stones out of their Beds, that made them break. For, besides that many of them, which (it seems) were not compressed enough, did not break, several of those, that did, were taken out, without offering them any such violence, as that their bursting could with any probability be imputed to it.

CHAP.

CHAP. IX.

Observat. VIII. *One main cause why such Motions as we speak of are overlook'd, is, That we are scarce wont to take notice but of those motions of Solid bodies, wherein one whole Body drives away another, or at least knocks visibly against it, whereas many effects proceed from the intestine motions produced by the external Agent, in, and among, the parts of the same body.*

THis Observation is like to be much more readily understood than granted, and therefore I shall offer by way of proof the following Experiments.

We caus'd in a large brass Stop-cock the movable part to be nimbly turned to and fro in the contiguous cavity of that part that was made to receive it, in that part of the Instrument that is wont to be kept fixt. And though this motion of the Key
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were made onely by the bare hand, yet in a short time the mutual attrition of the contiguous parts of the Instrument made so brisk an agitation in the other parts, that the incallescence made the metal it self to swell, insomuch that the Key could no more be turned, but remained fixt, as if it had been wedged in, so that, to make it work as before, it was necessary by cooling it to make it shrink a little, and so take off the mutual pressure of the Key, and the other part of the Stop-cock. Nor is this to be looked on as a casual Experiment; for, besides that it was made more than once, and is very analogous to some other trials of mine; I found, that a maker of such Instruments complained to me, that he was several times forced to intermit his work, and plunge his Instrument in cold water, before he could, by grinding, adjust the Key to the cavity it ought to fit.

I presume I need not take notice to you, that this Experiment confirms what

what I elsewhere mention of the dilatation of metals themselves by Heat, and therefore I proceed to the next Instance.

This is afforded by the known Experiment of passing one's wetted finger upon the orifice of a Drinking-glass almost fill'd with water. For, though the Eye does not immediately discern any motion, that, by reason of the pressure of the finger, is made by one part of the glass upon another; yet, That a vibrating motion is thereby produced, may be argued by the dancing of the water, especially that which is contiguous to the prest sides of the glass, by which 'tis oftentimes so agitated, that numerous drops are made to leap quite over, and others are tossed up to a good height into the Air. And that there may be considerable motions in the sides of the glass, whilst it does not break in pieces, we may probably guess by this, that, in Drinking-glasses artificially cut by a spiral line, both I, and others, have often

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often found by trial, that, a glass being dextrously inverted and shaken, the parts will vibrate up and down so manifestly, as sometimes to lengthen the glass, by my estimate, a quarter of an inch or more, and yet, the glass being set again upon its foot, it appeared that it had not been hereby at all injured.

That two pieces of Iron or Steel, by being strongly rubbed against one another, will at length acquire a temporary Heat, is not hard to be believed: but that an edg'd Tool of hardened Steel should, by having its edge rubbed against, have a manifest and permanent change made in its Texture, you did not perhaps suspect; and yet, having had the Curiosity to cause some metals, and particularly Iron and Steel, to be turned by an excellent Artificer, I learned partly by his experience, and partly by my own, that the edge of the Steel-tool, with which he by degrees shaved off the protuberant parts of the metal, would be so heated and agitated, that,

that, in no long time, if care were not taken to prevent it, the tool would be brought to look of blewish and yellowish colours, and, permanently losing its former temper, would become so soft, as to be uselesse for its former work, unlesse it were again artificially hardened: and therefore, to prevent the trouble of tempering his tools again, this Artist, from time to time, dipt it, when it began to grow too hot, into a certain liquour, which he affirms, upon much experience, to have a peculiar fitness for that purpose.

Nor is it always necessary that the body, that makes the parts of an inanimate body work considerably on one another, should be either very hard, or impetuoussly moved. For, I remember, that, having once by me some short bars of fine Tin, I resolved to try whether, meerly with my naked hands, (which you know are none of the strongest or hardest,) I could not procure a considerable internal Commotion among the parts; and

even languid Local motion. III

and accordingly, laying hold on the two ends of the bar with my two hands, I slowly bent the bar towards me and from me two or three times, and having by this means broke or cracked it in the midst, I perceived, as I expected, that the middle parts had considerably heated each other.

What use may be made of this Experiment in the search of the hidden cause of Elasticity, would be less properly considered in this place than in another. But since I have named that Quality, I shall take this rise to intimate, that if the restitution of a springy body, forcibly bent, proceed onely (as some Learned Moderns would have it) from the endeavour of the compressed parts themselves to recover their former state, one may not impertinently take notice of the Elasticity that Iron, Silver and Brass acquire by hammering, among the Instances that shew what in some cases may be done by a motion wherein the parts of the same body are, by
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an almost unheeded force, put to act upon one another. But if Springiness depend chiefly upon the pervasion of a subtile matter, as the *Cartesians* would have it, then the Instances will properly belong to another Subject.

§ The foregoing Examples may also suffice to make out (what I am unwilling to refer to another Head) this subordinate Observation, That men are more usually than justly prepossessed with an opinion, that nothing considerable is to be expected from the motion of a body against another, unless the former do make a manifest percussive or trusion of the latter. But, because this prepossession especially prevails in cases where the body that is by friction or attrition to affect the other, is itself soft or yielding, I shall on this occasion add a few Instances to remove this Prejudice.

An Artist, eminent for grinding of Optical glasses, confessed to me, that sometimes when he went about

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to polish his broader glasses, though but upon a piece of Leather sprinkled with Puttee, that friction did so heat or otherwise agitate the parts of the glass, as, to his great loss, to make it crack from the edge to the middle; which seemed the more strange, because we see, what intense degrees of Heat glasses will endure without cracking, if the fire be but gradually applied, as this Artist's glasses must have been gradually heated.

But I think it worth inquiry, whether in this case the whole work be performed by meer Heat, and whether there intervene not a peculiar kind of motion, into which some bodies are disposed to be put by a peculiar kind of friction, which seems fitted to produce in manifestly springy bodies, and perhaps in some others, (of which divers may be springy that are not commonly taken to be so,) such a vibrating or reciprocal motion, as may have some notable effects, that are not wont to be produced by

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moderate Heats, nor always by intense ones themselves. The trembling of the parts of a Drinking-glass, and the visible vibration of the long and great strings of a Base-viol, upon peculiar sounds, may give some countenance to this conjecture. And that in some bodies there may be such a tremulous motion produced, by rubbing them upon so soft a thing as Wool, or upon a piece of Cloath, I tried by this Experiment :

We cast into a hollow Vessel, very smooth within, and of an almost Hemispherical figure, severall ounces of good melted Brimstone, and having suffered it to cool, and taken it out, the Convex surface, as had been desired, came off well polished ; then this conveniently shaped lump, which had (if I well remember) four or five inches in Diameter, being briskly rubbed in the same line forwards and backwards, upon a Cushion or some such woollen thing, in a place free from other noises, I could, by holding my ear to it, and attentively listening,

stening, plainly hear a crackling noise made by the agitated parts, which continued a brisk, and, as I supposed, a vibrating motion for some time after the friction was ended.

That there may be a considerable Commotion produced among the internal parts of bodies, by rubbing them even against soft bodies, I have divers times observed, by the sulphureous steams that I could smell, if, after having a little rubbed a lump of good Sulphur upon my Cloaths, I presently held it to my nose. Which brings into my mind, that I have had the like effect from much harder and closer bodies than Sulphur, when they were rubbed upon bodies that were so too. For having purposely taken hard Stones cut out of mens Bladders, and rubbed a couple of them a little against one another, they quickly afforded, as I expected, a rank smell of stale Urin.

That Diamonds themselves will, by rubbing upon woollen cloaths, be made Electrical, seems to argue, that

even Their parts are set a moving: And that the Commotion reaches to the internal parts, I am the more apt to think, because I have a Diamond, that, if I rub it well and luckily against my Cloaths, will, for a little while, shine or glimmer in the dark; which is the same Phenomenon that I elsewhere relate myself to have produced in the King's larger Diamond, by giving it one brisk stroke with the point of a bodkin, where the Light that presently appeared in the Gem, seemed not referable to any thing so likely as the sudden Commotion made in the internal parts of that peculiarly constituted Stone.

What a peculiar modification of motion, distinct from its degrees of *Impetus*, may doe in Fluid bodies, we have formerly in this Essay taken notice of. But perhaps it may be worth while to enquire, what kinds there are of it, and what effects they may have in the parts of Solid bodies themselves. For I have observed,

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ved, that though those Stones that the *Italian* Glafs-men use are very hard, and, if I misremember not, have several times afforded me sparks of fire by Collision; yet, by rubbing them a little one against another, I found, that such an agitation was made in their parts, as to make them throw out store of foetid exhalations: And 'tis possibly to the stony Ingredient that Glafs owes the Quality I have observed in it, and elsewhere mentioned, of emitting offensive steams. And 'tis remarkable to our present purpose, that, though so vehement an agitation of the parts, as is given to Glafs by Heat, when 'tis made almost red-hot in the fire, does not make it sensibly emit odours; yet barely by dextrously rubbing two solid pieces of Glafs against one another, one may, in a minute of an hour, make those fixed bodies emit such copious steams as I found, not onely sensibly, but rankly, foetid; though one would think those stinking exhalations very indisposed to be forced off, since they

were not expelled by the vehement fire, that the Glass long endured in the furnace where 'twas kept melted.

There are few things that shew better, both how the parts of Inorganical bodies communicate their vibrating motions to one another, and how brisk those motions are, than that which happens upon the striking of a large Bell with a Clapper or a Hammer. For though the stroak be immediately made but upon one part; yet the motion, thereby produced, is propagated to the opposite, and the successive vibrations of the small parts do, even in so solid and close a body as Bell-metal, run many times round; as may appear by the durability of the ringing noise, which seems plainly to proceed from the circularly successive vibrations of the parts, which, unless they briskly tremble themselves, can scarcely be conceived to be fitted to give the Air that tremulous motion, whose effect on the Ear, when the first and
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loud noise, made by the percussion, is past, we call Ringing. And this motion of the parts of the sounding Bell may be further argued by this, that, if the finger, or some other soft body, be laid upon it, the sound will be checked or deaded, and much more, if a broad string, though of a soft substance, be tied about it. And not onely an attentive Ear may often make us guess, that the ringing sound is produced by a motion propagated circularly in the Bell, but this vibrating motion may sometimes be also felt by the tremulous motion communicated by the trembling parts of the Bell to the finger, that is warily applied to it. That this motion passes in a round, from one side of the Bell to the other, seems manifest by the great difference of sound, especially in regard of ringing, that may be observed in a sound Bell, and in a crack'd one; where yet all the matter and the former figure are preserved, onely the intireness or continuity, which is necessary to the circu-

lation (if I may so call it) of the tremulous motion, is at the Crack stopt or hindred. And that the motion of the parts is very brisk, may be guessed partly by what has been said already; but much more if that be true, which, not onely is traditionally reported by many, but has been affirmed to me by several Artificers that deal in Bells, who averred, as an experienced thing, That if a conveniently sized Bell were bound about, any thing hard, with a broad string, and then struck with the usual force, that it would otherwise bear very well; that percussioⁿ would break it, giving a disorderly check to the brisk motion of the parts of the Bell, whereof some happening to be much more (and otherwise) agitated than others, the force of their motion surmounts that of their Cohesion, and so produces a Crack.

But, in regard great Bells are not easie to be procured, nor to be managed when one has accessse to them, I shall add, that I took the Bell of a
large

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large Watch, or very small Clock made of fine Bell-metall, which had no handle or other thing put to it, save a little Bodkin or skiver of wood, whose point we thrust into the hole that is usually left in the middle of the *Basis*; and this sharp piece of wood serving for a handle to keep the Bell steady enough, we placed in the cavity of it, near the edges, (for that Circumstance must not be omitted,) some black mineral Sand, or, in want of that, some small filings of Steel or Copper, or some other such minute and solid Powder, which yet must not be too small, and then striking moderately with the Key against the side of the Bell, we observed, (as we expected) that, whilst it continued briskly ringing, it made many of the filings to dance up and down, and sometimes to leap up, almost like the drops of Water, formerly mentioned to skip, when the brim of the Glass was circularly prest by the wetted finger. Which prompts me to add, that, having put a middle-sized

sized drop of water (for in this case the quantity is a considerable Circumstance) near the lower edge of the Bell, 'twas easie to make it visibly tremble, and be as it were covered over with little waves, by a somewhat brisk stroke of the Key on the opposite side. And this effect was more conspicuous, when a very large drop of water was placed near the edge, on the convex side of a hand-Bell, whose Clapper was kept from any where touching the inside of it. And to obviate their jealousy, that, not having seen the manner of the above-mentioned motion of the Sand, might suspect that 'twas produced by the impulse which the Bell, as an intire body, received from the percussion made by the Key, we several times forbore putting-in the filings, till after the stroke had been given; which satisfied the Spectatours, that the dancing and leaping of the minute bodies proceeded from the same brisk vibrations of the small parts of the Bell, which, at the same time striking

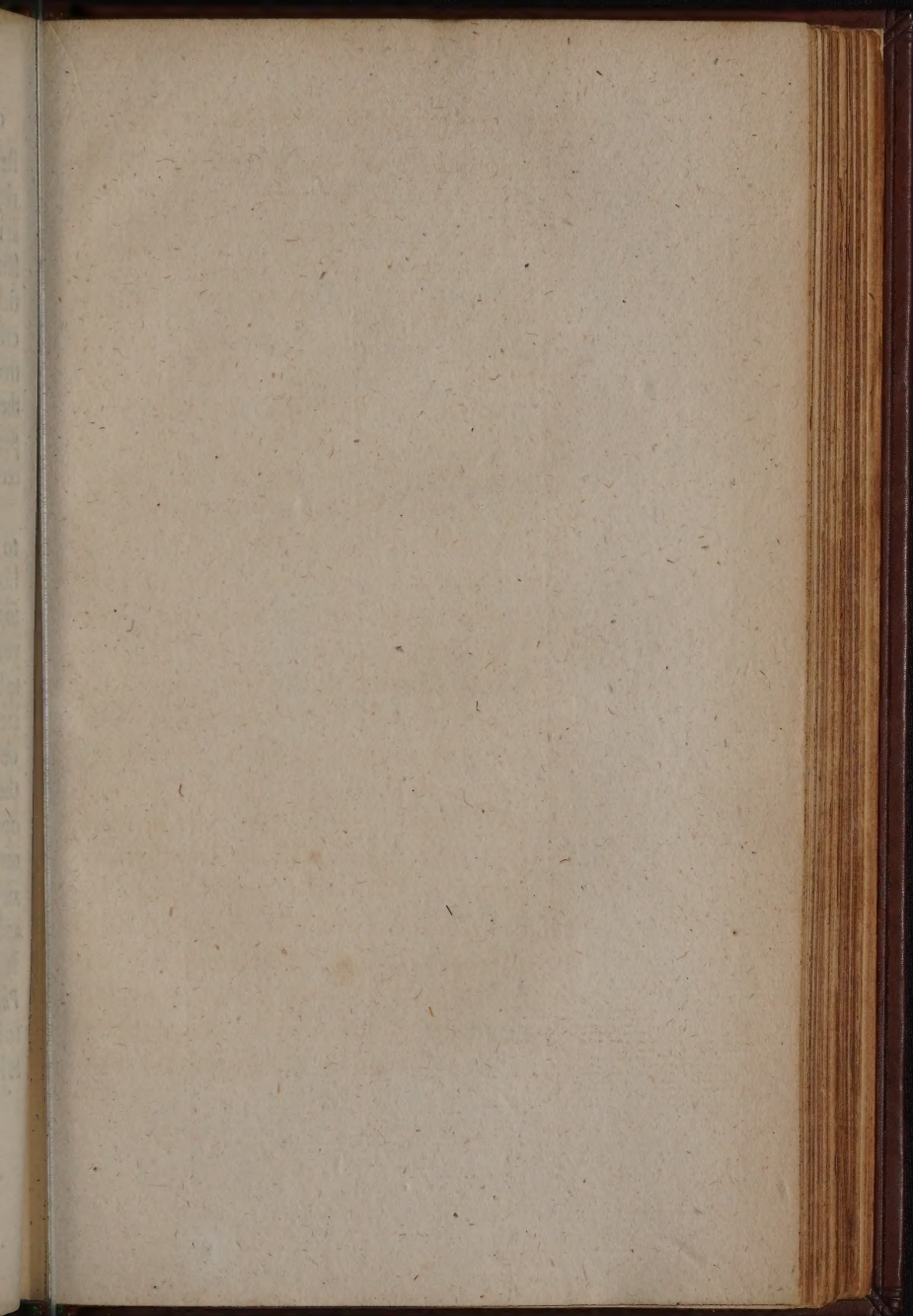
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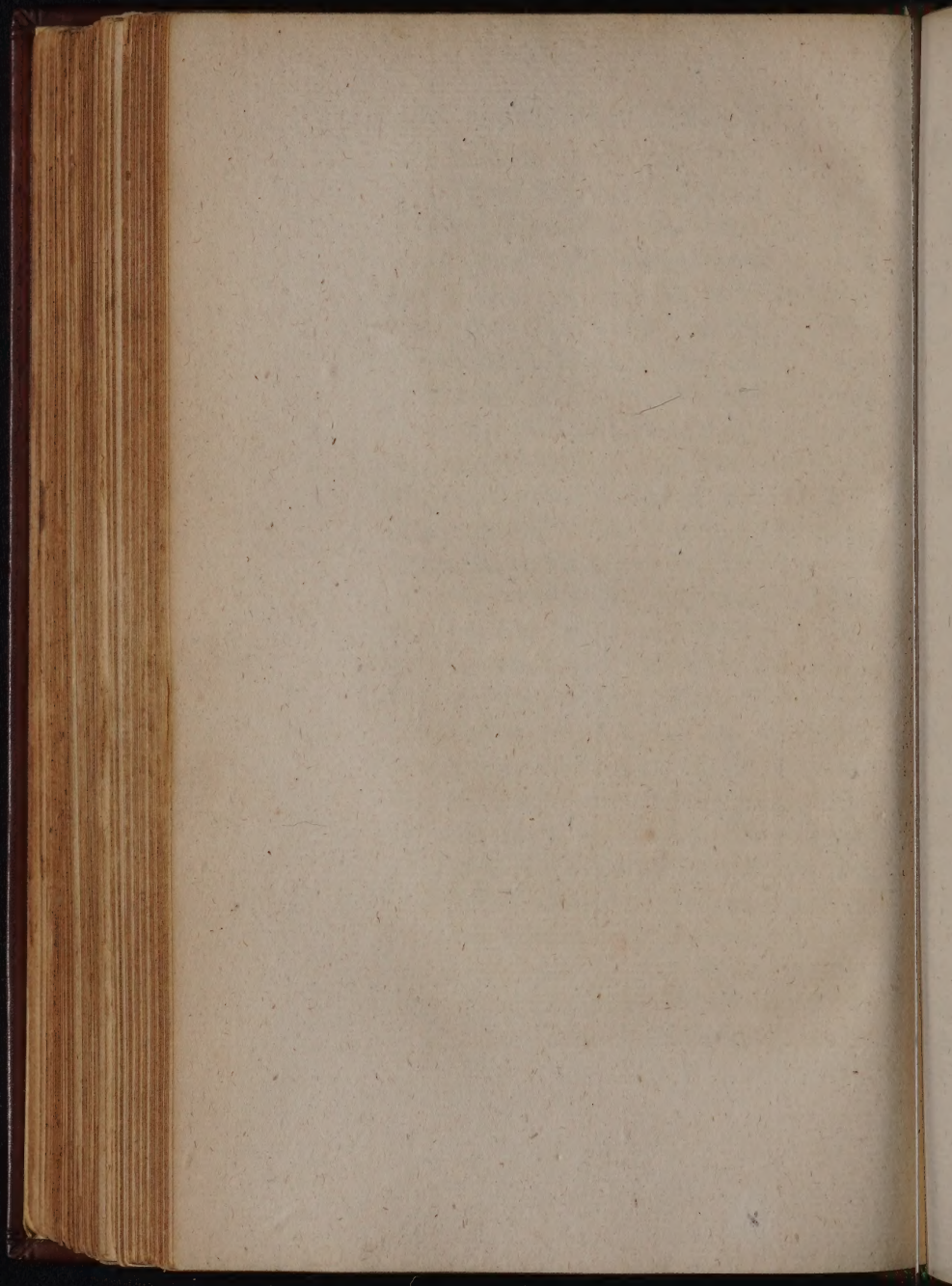
striking also the Air, produced a ringing sound, which might very well, as it did, out-last the skipping of the filings; the exceedingly minute particles of the Air being much more easily agitable, than the comparatively gross and heavy Corpuscles of the Powder. And this success our Experiment had in a Bell, that little exceeded an inch and half in Diameter.

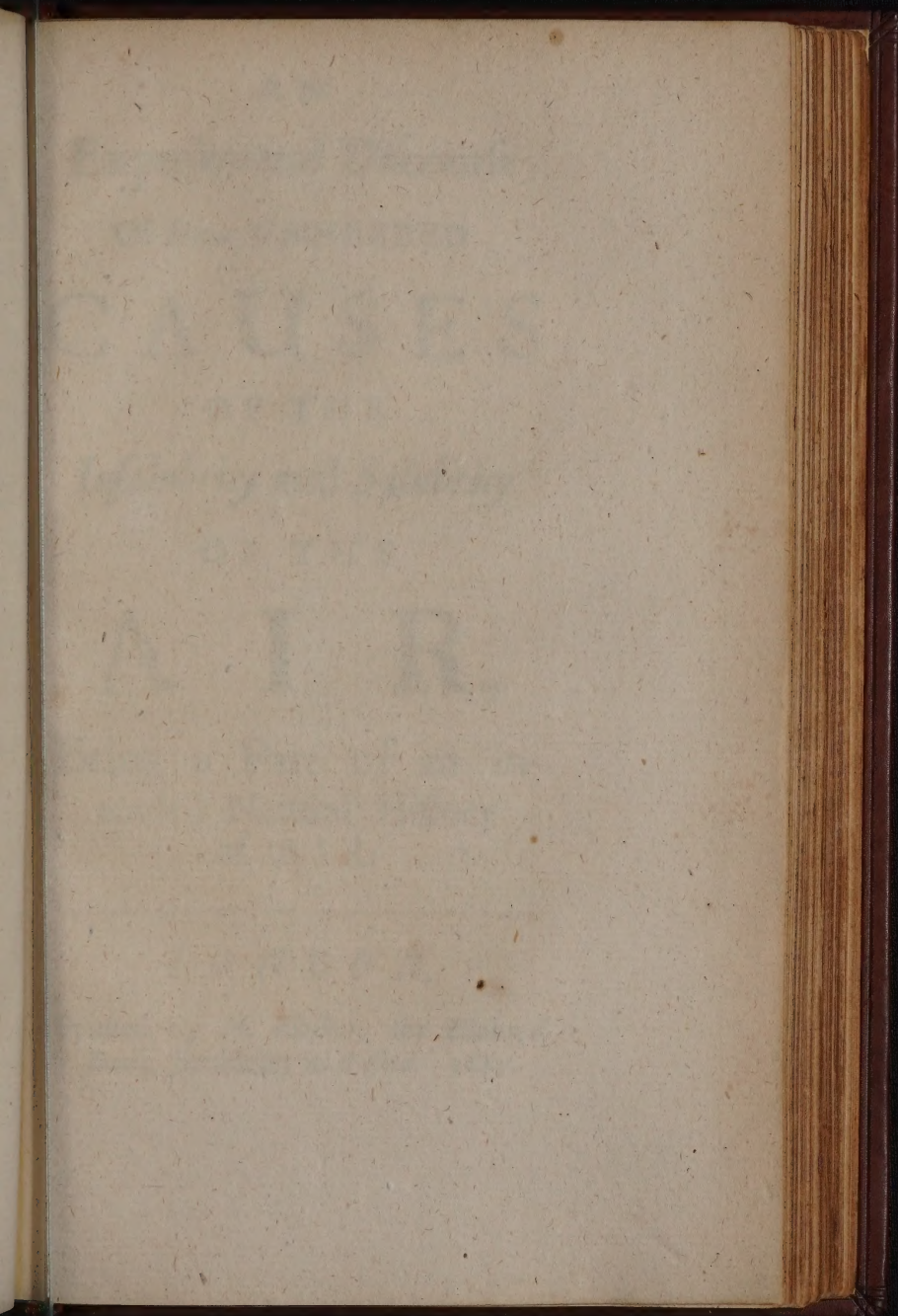
And here, *Pyroph.* I shall put an end to this Rhapsody of Observations, hoping, that, among so many of them, some or other will be able to engage you, if not to conclude, yet at least to suspect, that such Local motions, as are wont either to be past-by unobserved, or be thought not worth the observing, may have a notable operation, though not upon the generality of bodies, yet upon such as are peculiarly disposed to admit it, and so may have a considerable share in the production of divers difficult *Phænomena* of nature, that are wont to be referred to less genuine, as well as less intelligible, Causes.

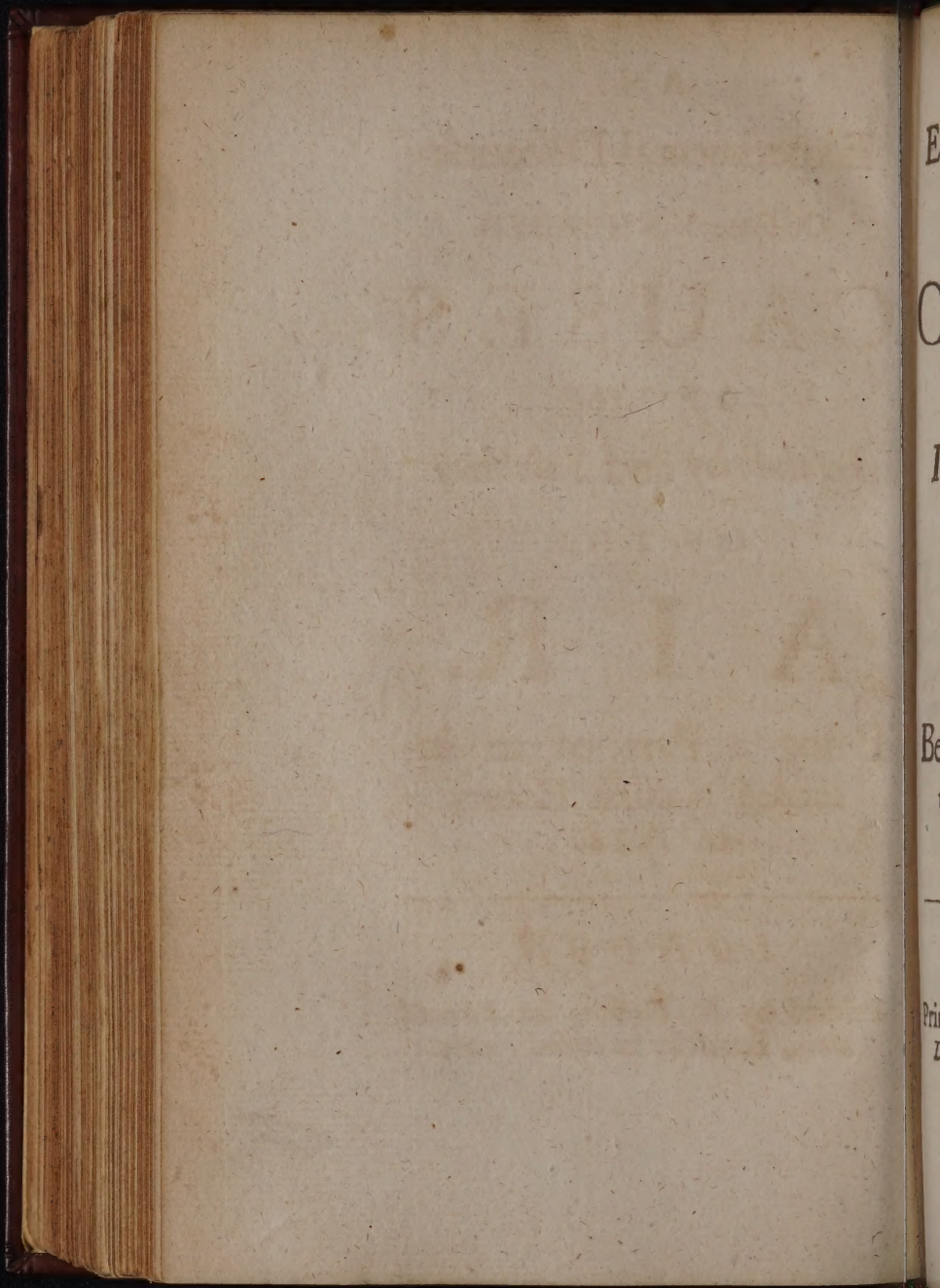
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 First, also the Air, produced a
 ringing sound which might very well
 as it did, out-late the skipping of the
 fish; the exceedingly minute par-
 ticles of the Air being much more
 easily agitated than the compar-
 atively gross and heavy Corporcles of
 the Powder. And the success our Ex-
 periment had in a bell, that first ex-
 ceeded an inch and half in Diameter
 And here, Pardon I shall put myself
 to some Philosophy of Observation;
 hoping that among to many of them;
 some or other will be able to excuse
 you, if not to convince. Yet at least
 to let you see that such local motions as
 are wont either to be fast by us
 observed, or be thought not worth
 the observing, may have a notable
 operation, though not upon the gen-
 erality of bodies, yet upon such as
 are peculiarly disposed to admit it;
 and so may have a considerable share
 in the production of divers diseases
 & many of our diseases are wont
 to be referred to the generation of wind
 as the leading cause









AN
Experimental Discourse
Of some UNHEEDED
CAUSES
OF THE
Insalubrity and Salubrity
OF THE
AIR,
Being a Part of an in-
tended Natural History
of AIR.

L O N D O N,

Printed by *M. Flesher*, for *Richard
Davis*, Bookseller in *Oxford*. 1685.

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Printed by M. Miller, for Richard
 Davis, Bookseller in Oxford. 1732.

THE Preface.

HAVING heretofore had occasion to draw together under certain Heads, divers unpublish'd Observations and Experiments of my own, and some of other men, by way of Memorials for a Natural History of the Air; I thought fit by more largely treating of two or three of the Subjects distinctly mention'd in my Scheme of Titles, to give a Semplar or Specimen of what may be done upon the other Heads of the designed History. Upon this ac-

The Preface.

count I treated somewhat largely of the Salubrity and Insalubrity of the Air, as a Subject, which for the importance of it to Mens healths and lives, I thought deserv'd to be attentively consider'd, and have its Causes diligently inquir'd into. And having observ'd that among the six principal Causes of the healthfulness or insalubrity of the Air, namely the Climate, the Soil, the Situation of the Place, the Seasons of the Year, the rainging winds and Contingencies (whether more or less frequent) and especially Subterranean Steams, having I say observ'd that among these Causes there was one, viz. the last nam'd, about which, I thought I could offer something, that I had not met with in the Books of Physicians that treat of it; I was thereby invited to set down my Thoughts and Observations by way of Conjectures, which I was made to believe would appear uncommon, and
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would not prove useles. These Observations and Reflexions I referr'd for clearness and distinctions sake to four Propositions. But when I had gone thorough the three first, and made some progress in the fourth, being hinder'd by divers Avocations to make an end of it, I laid by the whole Discourse in a place which I thought a safe one, but when afterwards I had some opportunity to dispatch what remain'd, I found all the diligence I us'd to retrieve the entire Manuscript unsuccesfull. At this surprizing Accident I confess I was somewhat troubled; because whatever may be thought of the discursive part of those Papers, the Historical part contain'd divers matters of Fact, that I did not meet with in Books, nor can now distinctly remember, and will not perhaps be lighted on by even Physicians, or such Naturalists as derive their knowledge one-ly

The Preface.

ly from them. 'Tis upon this consideration, that having afterwards met with many Papers that belong'd to most parts of the unhappy discourse, I thought fit to put them together in the best order I could, that I might not loose what might give some light to so important a Subject as the Theory of Diseases. And this course I the rather pitch'd upon, because before the Papers about the Salubrity of the Air, I mis'd two other of my Manuscripts, whereof the former contain'd a Collection of Medicinal things, and the second a defence of the Mechanical way of Philosophizing about Natural Things, as it respects Religion. And I remember'd that having formerly lost a Manuscript I was much concern'd for, I purposely made a noise of it, whence I suppos'd the Plagiary would conclude himself unable to make it pass for his. And in effect
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The Preface.

the Book was in a while after privately brought back, so that I found it laid in a By-place, where I had before as fruitlessly as carefully sought it.

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The Preface.

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decay & brought back to me I found
it laid in a heap of rubbish & had
before me a quantity of empty sheets.

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THE sixth and last thing upon which the Salubrity and Insalubrity of the Air depends, is the impregnation it receives from Subterranean *Effluvia*. And, though this be a cause not wont to be much heeded by Physicians themselves; yet I take it to be oftentimes one of

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the most considerable in its effects.

The *Effluvia* that pass into the Air, may be distinguish'd into several sorts, according to their respective Natures, as has been elsewhere shewn; wherefore I shall now only take notice of the differences that may be taken from *place* and *time*; upon which account we may consider, that some of them arise from the *Crust* (if I may so call it) or more superficial parts of the *Earth*; and others have a deeper Original, ascending out of the lower parts, and as it were *Bowels*, of the *Terraqueous* Globe. And to this difference taken from place, I must add another, perhaps no less considerable, afforded by *Time*; which difference relates chiefly to the second sort of *Steams* newly mentioned.

Of the Subterranean *Effluvia*, some are almost constantly or daily sent up into the Air, and those I therefore call *Ordinary Emissions*; and others ascend into the Air but at times, which are not seldom distant

stant enough from one another, and those I call *Extraordinary Emissions*; whether they come at stated times, and so deserve the title of *Periodical*, or else uncertainly, sometimes with far greater, sometimes with far smaller intervals, and so may be called *fortuitous* or *irregular*. But, though I thought it might render what I am about to say more clear, if I made and premised the two foregoing distinctions, yet because in many cases, Nature does not appear solicitous to observe them, but at the same time imbues the Air with Steams referable to divers Members of these distinctions, I shall several times, though not always, take the liberty to imitate her, and consider the *Effluvia* of the *Terraqueous Globe*, in the more general Notion, that they are so.

I know 'tis frequently observed, and usually granted, that *Marrish* Grounds, and *wet* Soils are wont to be *unhealthfull*, because of the moist and crude vapours, that the stagna-

ting waters send up too copiously into the Air. And on the other side, *dry* Soils are, because of their being such, generally lookt upon as *healthy*. Nor do I deny, that these Observations do most commonly hold true; but yet I think, that besides what can be justly ascribed to the moist vapours, or dry Exhalations, we have been speaking of; in many places the healthfulness and insalubrity of the Air may be ascribed to other sorts of *Effluvia* from the Soil, than those that act merely, or perhaps principally, as these are either *moist* or *dry*.

PROPOSITION I.

TO deliver my Thoughts about this matter somewhat more distinctly, I shall lay them down in the four ensuing Observations or Propositions, whereof the first shall be this: *It seems probable that in divers places, the Salubrity or Insalubrity of the Air considered in the general, may be*

be in good part due to *subterranean Expirations*, especially to those that I lately call'd *Ordinary Emissions*. For in some places the Air is observ'd to be much more healthy, than the manifest qualities of it would make one expect: and in divers of these Cases I see no Cause to which such a happy Constitution, may more probably be ascrib'd, than to friendly *Effluvia* sent up from the Soil into the Air; which Particles either by promoting *transpiration* (that great instrument of health and recovery;) or by hindering the production, or checking the Activity, of Morbifick ferments; or by mortifying and disabling some noxious Particles, that would otherwise infect the Air, or by other ways, that I shall not now stay to enumerate; may not a little contribute to keep the Bodies of those that live in that Air, in that regular and desirable state, we call *Health*. I know indeed that 'tis generally thought, and often true, that Mineral Bodies do

send up Exhalations, hurtfull not only to Plants, but to Men ; but when we mean Subterranean things indefinitely, though (Men are wont to look upon them but slightly under a general confused Notion) we employ a word more comprehensive than most men are aware of, there being a great variety, as well as multitude of Bodies, that Nature has lodg'd in her dark Store-houses under the surface of the Earth. And of these differing sorts of Bodies, though 'tis probable that the greatest part are such whose *Effluvia* are unhealthfull to Men, yet there may be others whose Emanations may be friendly to him ; I have known it observ'd that over some Tin Mines in the Western parts of *England*, not only Trees, but far more tender Plants, as Grass, are wont to prosper and flourish, and (if I much misremember not) I have seen verdent Trees growing just over a vein of another sort of Mineral, that lay near the surface of the Earth ; And 'tis like-

likewise observable about those that constantly dig in those Tin-Mines, that they do not lead a short and sickly life as in many others, but arrive at a great and vigorous Age. And an Ancient Possessor of some of these Mines being askt by me, whether amongst the otherwise differing Exhalations that ascended into the Air, he did not find a difference as to smell bad or good ; he answer'd, that though most of those visible fumes had a smell that participated enough of Sulphur or Bitumen to be offensive, yet some others were so far from being ungratefull, that they were well scented. And on this occasion I remember, that not long since, a Friend of mine, and another *Virtuoso*, being Partners in a chargeable Attempt to discover a Mine, in digging deep for it, they accidentally broke into a vast Subterranean Cavern, into which, because the Diggers would not venture to descend, one of these curious Gentlemen caused himself to be

let down, and there found the Air very temperate and refreshing, and that he long breath'd it with delight, and on the floor, or Soil (which reach'd farther than he could discover) he found many and various Minerals most of them embryonated, or imperfectly form'd, and store of a kind of Mineral Earth, whose smell was fragrant and very pleasant both in his Judgment, and that of some Ladies. And though, when some of those Minerals were brought to me, a small lump of this Earth that was among them, had been kept so long in the Air, as to spend most of its Odoriferous Particles, yet the smell it still retain'd, was, though but faint, yet pleasing.

That from Fossiles that lye hid under the surface of the Earth, and have a considerably large Spread, there may ascend store of wholesome *Effluvia* into the Air, seem'd to me the more probable by what I noted at my last being in *Ireland*, where, being invited by a Brother of mine

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to pass some time in a Countrey house of his, to which there belong'd a very large Sheep-walk that produc'd short, but excellent Grass; I learn'd (and was easily perswaded by some things I took notice of) that this place was justly reputed very healthfull, and this Salubrity of the Air, together with the sweetness of the Grass, some circumstances invited me to ascribe to *this*; That the Soil was sustain'd by a large tract of Limestone, which I suppos'd to emit continual exhalations into the Air; which conjecture will perhaps with the less scruple be assented to, if I add that it has been long and generally observ'd, that as far as the Limestone extends, that tract of ground makes the Snow *that* falls on it thaw, or melt much sooner, than it does on the Neighbouring Lands.

After I had made this Observation, I mention'd it in discourse to an inquisitive Person, that had seen and been employed about several Mines; and I asked him whether he had met
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with any thing of this kind ; to which he answer'd me, that in *Derbyshire*, at a place which he nam'd to me, he and others had observ'd, that a large tract of Limestone land was so warm (as they speak) as to dissolve the Snow that fell on it, very much sooner than another great scope of Land, which was divided from it but by a glin, where the Soil did not cover Limestone, but Free-stone.

Afterwards, discoursing of this Subject with an ingenious Person, that had visited the *Hungarian*, and *Bohemian* Mines ; he told me, that during his stay among the former, he often walked abroad with the Overseer of them, a famous and experienc'd Mineralist, who delighted to breathe the fresh morning Air upon some Hills abounding with Minerals ; that his Guide made him observe, that when they were over a tract of Land that afforded much of that noble Oar (which by a *German* Name he called *Rot-gulden ertz*) he found

found the smell to be pleasing, and the Air refreshing. And whereas, in passing over some other Mines, he found himself molested by offensive fumes; he felt no such effect, when he was upon that scope of ground under which there lay veins of *Cinnabar*, or, if you please, a Mine of *Quick-silver Oar*: And his ancient Guide told him, that next the *Rotgulden ertz* before mentioned, the Soil containing these Cinnabarine veins, was that whose incumbent Air was the most eligible for pleasantness and Salubrity. And I the less wonder, that in some places the subjacent Fossiles should impregnate the Air with wholesome *Effluvia*, because I remember I had the Curiosity to ride many Miles, (though in the depth of Winter,) to see a scope of ground that was famous for a good Pottery; where, besides many other Mineral Earths that I took notice of, there was a Pit or Groove, that reach'd, if I mistake not, fifteen or twenty foot beneath the surface of the ground;

ground; whence they dug up a kind of white Clay, so richly impregnated with subtile and noble parts, that it afforded a Chymist or two of my Acquaintance (for I had my self no opportunity to distill it) good store of a Subtile Spirit, of a Volatile and Saline Nature, which upon trial they highly extoll'd for it's Cordial, and other Virtues in Physick; and which, by some peculiar Mechanical trials I made with it, I concluded to abound with a Volatile Salt, not unlike that of Urine or Hartshorn. And since by this instance we see, that some unsuspected Fossiles may be enrich'd with Medicinal and Fugitive Salts and Spirits; it may reasonably be suppos'd, that these ascending into the incumbent Air, may highly conduce to the Salubrity of it. And the Curiosity I have had to examine Chymically some Boles, and other Bodies, which are wont to be unregardedly compriz'd under the confus'd notion of *Earths*, makes me suspect, that

that there may be far more *Species* of Salubrious Fossiles than many have yet taken notice of.

But peradventure you will much the more easily admit in general, that Subterranean Tracts of great extent may for a very long time send up into the Air copious Expirations, not discernable by any of our senses, nor commonly suspected to be found in that Body, if you please to consider with me (what I do not remember to have been taken notice of to this purpose) that the common Air we live in, and breathe, does always abound, and for many Ages has been impregnated, with the Copious Magnetical *Effluvia* of the Earth; which our industrious *Gilbert*, and after him some learned Jesuits and others, have proved to be a great, though faint *Magnet*; and whose emanations, as they constantly stream through the Air, I have elsewhere by particular Experiments shewn to be capable of passing through the Pores of Glass it self, and acting almost instantaneously

taneously, and yet manifestly, upon Bodies hermetically seal'd up in it. But, *though* from what has been said it may be infer'd, that 'tis not improbable the Salubrity of the Air in some places may be chiefly, or at least in part, due to the wholesome Expirations of Subterranean Bodies ; *yet*, generally speaking, the Air is deprav'd, in far more places than it is improv'd, by being impregnated with Mineral Expirations. And indeed, besides that, among the Minerals known unto us, there are many more that are *noxious*, than that are *wholsome* ; the power of the former to doe mischief is wont to be far more efficacious, than that of the latter to doe good ; as we may guess by the small benefit men receive in point of health by the *Effluvia* of any Mineral, or other Fossile, known unto us, in comparison of the great and sudden mischief that is often done by the Expirations of Orpiment, Sandarach, and white Arsenick ; for, though that sold in Shops

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is *factitious*, being made of Orpiment sublim'd with Salt, yet it is found *Natural* in some *Hungarian*, and other Mines. On which occasion, I remember that the ingenious Person lately mention'd to have with his Guide taken the Air upon the Hills of that Mineral Countrey, answer'd me, that, when his Guide and he walk'd over some veins of these noxious Minerals, he met with several Odorous Steams, which, though differing from one another, agreed in this, that they were all offensive to him; and particularly, some of them by their unwelcome sharpness, and others by giving him a troublesome difficulty of respiration. I will not here urge those sulphureous steams, that so suddenly deprive Dogs of sense and motion, in the Neapolitan *Grotta de Cani*; because there the Exhalations are too much included, and as it were pent up: But it is very proper to allege for my present purpose the *Aorni* or *Averni*, which are mention'd

tion'd by good Authours to be found, some in *Hungary*, and some in other Countries ; for in these places there ascend out of the Earth such noxious and plentiful exhalations, as kill those Animals that draw in the Air they infect ; and some of them are able to precipitate, even the Birds that fly over the Caverns that emit them. But there are a multitude of Places, where 'tis not so manifest that hurtfull exhalations ascend into the Air, and yet they really do so : There being in many places whole tracts of Land, that near the surface of the Earth abound with Marchasitical Minerals, as these do with a sharp vitriolate Salt, which, together with the ill condition'd Sulphur that they also plentifully contain, ascend into the Air, and render it corrosive. On which occasion I remember, that for Curiosities sake I took some English shining Marchasite ; and caus'd a pound of it to be distill'd in an Earthen Vessel with a good fire, by which means, notwithstanding it's dryness,

dryneſs, I obtain'd two or three ſpoonfuls of a Limpid Liquor, that ſmell'd very ſtrongly, like that which the *Helmontians* call *Gas Sulphuris*; and which appear'd manifeſtly to be of an acid Nature, both by the taſte, and by it's readily corroding, and diſſolving unbeaten Coral, even in the cold, to mention here no other Tryals that I made with it. And the Mineral afforded me, together with this Liquor, about an ounce and three quarters of inflammable *Sulphur*, part whereof aſcending (as may be gueſſ'd) in the form of very agile Corpuscles, theſe faſten themſelves all about to the inſide of the Receiver, and there compos'd divers thin Coats, or Films, as'twere, of Sulphureous matter ſticking to one another; which at their firſt taking off, and for ſome time after, might be bent or folded like leaves of paper, but afterwards harden in the Air. Mineraliſts, and ſome other good Authours, mention divers Places as abounding with Mar-

chafistical Fossiles, but I am apt to think, they are far more common than is vulgarly taken notice of; for I have met with them where one would little expect them. And, though in *England* all our Vitriol (which is now plentifully vended into Foreign parts) be made of Vitriolate Stones, or Bodies that pass for stones; yet that is not true which our Mineralists are wont thence to conclude, that there is no other Vitriolate or Marchasitical matter in *England*: for a famous dealer in Fossiles, having found a Mine, which he knew not what to make of, and therefore carefully conceal'd, address'd himself to me, because, he said, he knew I would not betray or supplant him: and having at his desire taken a private view of what he had discover'd, I presently found it to be a vein, that lay at some depth under ground, and ran along (how far I know not) like a vein of Metalline Oar, (and for such upon that account he mistook it) consisting of a black

a black and heavy stuff, which upon a few easie trials I quickly found to be of a Vitriolate Nature; inso-much that, somewhat to my wonder, I was able to make it yield in few hours store of pure Vitriol, without any troublesome or artificial preparation.

PROPOSITION II.

It is probable that in divers places some Endemical Diseases do mainly, or at least in part depend upon Subterraneal Steams.

UNder the name of *Endemical Diseases*, I do not comprise those onely that are very peculiar to this or that Countrey; as the *Plica* is said to be to *Poland*, (whence it receives its name of *Polonica*;) or an odd kind of *Colique* in one part of *France*, (from which 'tis called *la Colique de Poitou*;) but also those that are more rise in some Coun-
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tries than in most others ; such as *Agues* in *Kent*, and in that part of *Essex* they call the *Hundreds* ; the Consumption (though that be an ambiguous name) in *England*, whence Foreign Physicians call it the *Tabes Anglica* ; and *Fluxes* of the Belly in *Ireland*, where they are so rise as commonly to pass under the name of the *Country Disease*.

That these *Endemical*, or (if we may so call them) *Topical* Distempers, do in many places proceed from some excessive Heat, Moisture, or other manifest quality of the Air ; from bad Diet, vulgar Intemperance, and other Causes that have little or no connexion with *Subterranean Reeks*, I readily grant. But, that in some places the *Endemical Disease* may either be principally caus'd, or much fomented, by noxious *Effluvia*, I am inclin'd to suspect upon the following grounds.

1. There are some places, in which the *Endemical Disease* cannot be probably imputed to any manifest Cause ;

Cause; as he may perceive that shall consider how often it happens, that the Causes which are assign'd of such Diseases, if they were the true ones, must produce the like Distempers in many other places, where yet it is notorious that they are not *Endemical*.

2. That Subterranean Bodies may send up copious Steams, of different kinds, into the Air, has been already made out.

3. It has been also shewn, that the Matters that send up these *Effluvia*, may be of a large extent. And I remember on this occasion that I have sometimes observ'd, and that in more Countries than one, a whole tract of Land that abounded with Minerals of one kind; and within no great distance, as perhaps a Mile or a League, another large tract of Land, whose Subterranean part abounded with Minerals of a very differing sort.

4. We have also above declar'd, and 'tis highly probable from the

nature of the thing it self, that those copious steams (Saline, Sulphureous, Arsenical, Antimonial, &c.) that impregnate the Air, may very much conduce to make it hurtfull to a humane body, in the way requisite to produce this or that determinate Disease: as I not long since related from the Chymist that visited the *Hungarian* Mines, that in some places he found the Reeks ascending from them into the Air (though in an elevated place, and expos'd to the Winds) make him as it were Asthmatical, and give him a troublesome difficulty of Respiration. And here let me add an Observation, which perhaps will not be thought fit to be slighted by Physicians: namely, that some parts of the substance of the Air (for I speak not of its Heat, Coldness, or other such Qualities) do not onely affect humane bodies, or at least many Individuals among them, as they are taken in by Respiration, but as they outwardly touch the Skin: and the skin

Skin being (as I have elsewhere shewn) full of Pores, and those perhaps of different sizes and figures, those Corpuscles that get in at them may have their operation, even upon the most inward parts of the body. To make this more clear and probable, because 'tis a thing of importance, I desire these things may be observ'd.

1. That when I speak of the Air, I do not in this place understand that Air, which I elsewhere teach to be more strictly and properly so call'd, and to consist of *springy* Particles; but the Air in its more vulgar and laxe signification, as it signifies the Atmosphere, which abounds with vapours, and exhalations, and in a word with Corpuscles of all sorts, except the larger sort of springy ones; and many of them may be so small, and so solid, or so conveniently shap'd, as to get entrance at some of the numerous Orifices of the minute or miliary Glandules of the Skin, or at other Pores of it.

Thus, though paper be not pervious to the uncompress'd elastical parts of the Air, yet it may be easily penetrated by other Corpuscles of the Atmosphere: for I remember, I have for Curiosities sake prepar'd a dry body, out of a substance belonging to the Animal Kingdom, which being lapt up in paper, would, without wetting or discolouring, or any way sensibly altering it, pass in a trice through the Pores of it in such plenty, as to have not onely a visible, but a manifest operation on bodies plac'd at some distance from it. And though a bladder almost full of Air, having its neck well tyed, be held near the fire in various postures, the elastical Air, though rarefied, or attenuated by the heat, will rather burst the bladder, (as I have more than once found) than get out at the Pores, yet we have often made a certain substance, belonging to the Mineral Kingdom, that, if a bladder were wet or moist, (as the Skins of living Men are wont to be) would readily

ly pervade it, and have a sensible operation, even upon solid bodies plac'd within it. This Experiment (that I can repeat when I will) is therefore the more considerable to our present purpose, because in the bladder of a dead *Animal*, the Porosity may be well suppos'd to be much less than it was in the Animal when alive; in which state the parts of the humane body are much more perspirable than one would easily believe, partly because of the heat that is continually diffus'd from the heart, and partly because of the copious steams that are in perpetual motion, and keep the parts warm, moist and supple: And it is not to be pretermitted in our present instance, that the bladder of Urine consists not of a single Membrane, and is probably of a stronger texture, by reason of the subtile salt liquor it is instituted to contain, than many another Membranes of the body, or the Epidermis. And this is the first thing I would have noted.

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The next is, that, whereas in the Instances newly recited, and some others that are by and by to be mention'd, the effects were produc'd when the ambient Air, impregnated with Mineral Corpufcles, had but a very fhort time (perhaps not many minutes) to work upon the bodies expos'd to it : In thofe Countries that are very fubject to Endemical Difcafes, the Inhabitants are wont to live all the year long, and perhaps during their whole life, expos'd to the action of the vitiated Air : and how much a far fhorter time will ferve, to make the Corpufcles that rove in the Air, penetrate into bodies of no very clofe contexture, may be guefs'd by the breaking even of the bigger ftrings of Lutes and Vials, by the numerous (though invifible) vapours, that get into them in rainy weather ; and much more by the effects of fuch vapours, when infinuating themfelves in fwarms into the Pores of a Rope, they fhorten it fo forcibly, as to enable it, by fhrinking

king it self to lift up and keep suspended considerable weights, as I have elsewhere shewn by tryals purposely made. These things may render it probable, that, *though* in a small compass of time the noxious *Effluvia* that rove in the Air, may be too thinly dispers'd in it, to insinuate themselves in any considerable number at the Pores of the Skin; *yet*, by reason of the continual contact of the Air, (especially as to the Face, Hands, and some other parts) which may last day and night for many months, or perhaps years, there may be opportunity for a considerable number of morbidick Particles, to insinuate themselves into the cutaneous Pores.

3. And thus having once got entrance, they may by the capillary Vessels that reach to, or terminate at the Skin, pass on to somewhat larger Vessels; and so may get into the mass of blood, and by its Circulation be carried to all the parts of the body; and so be enabl'd both to de-

deprave the bloud, and other juices themselves, and to gain access to any determinate part of the body, which their peculiar shapes, figures, &c. qualifies them to produce some particular Distemper in. This whole Doctrine may be made more probable, by what experience shews of the virtues of certain *Plasters*, especially *Mercurial ones*, in Distempers that are not at all, or at least are not chiefly *Cutaneous*; and (which comes more home to our Argument) of the efficacy of *Periapta*, and *Appensa*, such as *Piony-root*, *Bloud-stone*, *Lapis Nephriticus*, *Quick-silver* in a Quill, a dry'd Toad in a Cefnet Bag, &c, whereof, though many answer not the Characters that are wont to be given of them, yet some of them, experience has convinc'd me to be of greater efficacy than I expected: And much more activity may be presum'd to be, in divers noxious *Effluvia* from *Subterranean Bodies*; as may be gather'd from the effects of the *Mercurial Girdles*, that some unwary

wary persons wear to cure the Itch; and from what I elsewhere relate of the fits of the *Colicque*, often produc'd in a Friend of mine by the *Effluvia* of masses of *Loadstone*. And this last example may serve for a proof of another part of our *Hypothesis*, by shewing that *Mineral Effluvia*, may not onely be noxious in a general way, but may produce this or that determinate Disease. That *Arsenical Appensa*, though much extoll'd by divers *Physicians* themselves, and sold dear by *Empyricks*, as (if worn near the Heart) wonderfull *Amulets* against the *Plague*, have (especially in some persons and circumstances) produc'd some of the noxious effects of *Arsenical Poysons*, and particularly caus'd in some great faintness and dispiritedness, I find by the Testimony of divers eminent *Physicians*. To which I shall add a remarkable one, which may probably be referr'd partly to this third Observation, as well as to what I lately deliver'd about the bad effects
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of *Mineral Exhalations*, breath'd in with the Air they vitiated : and I therather mention this Case, because 'tis not onely an odd one, but is a considerable Argument to shew, that noxious *Mineral Expirations* may manifestly produce a determinate Distemper in unlikely parts of the body. The Observation is this ; I knew, and on some occasions employ'd, a *Chymical Laborant* that fanci'd that he could make a rare Medicine out of *red Arsenick*, (as some call what others style *Sandarach*,) which is thought to differ little from common *Orpiment*, saving its being much higher colour'd : this *Laborant* then working long and assiduoussly upon this Mineral, and rubbing it frequently in a Mortar, came divers times to me ; and complain'd of a *disaffection* he thence contracted in the *Organs of Respiration* ; for which I gave him something that happen'd to relieve him ; which encourag'd him to complain to me of another Distemper, that, though
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not so dangerous, did often very much molest him: which was, that when he was very assiduous in the preparation of his *Sandarach*, it would give him great *Pains*, and (if I misremember not) some *Tumours* too, in his *Testicles*: And this, for ought I know, happen'd to him as long as he was earnest about that Process; for the Medicines that had reliev'd him in his other Distemper, did not remove this: and I having occasion to go for a while into the Countrey, found him gone at my return. It may strengthen the Conjecture lately propos'd, of the possible insinuation of *Effluvia* that rove in the Air, at the Pores of the Skin, if I add that I have had the Curiosity to enquire of more than one Traveller, that had visited the famous *Pico of Tenarif* (at whose upper part there are found scatter'd parcels of *Sulphur*, and divers manifest tokens of a *Vulcan*) whether the *Sulphureous Steams* (that I suppos'd to be copious near the top of the Moun-

Mountain) did not work upon the *silver* Money they had in their Pockets, and discolour it: to which he answer'd that 'twas no uncommon Observation, to find at mens return from visiting the top of the Hill, that the Money they carried about them was blackn'd, and that he himself had particularly observ'd it to be so: which might easily gain credit with me, who have divers times made a preparation of *Sulphur*, which, even in the cold, sends out exhalations so penetrant, that, having for tryals sake put some pieces of Coyn (which ought not to be Golden) into a Leather Purse; they were able, and that in not very many minutes, to discolour manifestly the Money, in spite of the interposition of the Purse that contain'd it. But I had a more considerable instance of the efficacy of the Sulphureous Expirations of the *Pico of Tenarif*, by a sober Person that is one of the chief Directours of the famous *East-India-Company* of *London*; who, being

being question'd by me about some circumstances of his Journey to visit the top of that stupendious Mountain, answer'd me, that among other effects the Sulphureous Air had upon him, (who is of a very fine complexion) he found at his return to the bottom, that his light-colour'd Hair had manifestly changed colour, and was in many places grown forked at the ends. These Observations may make it probable, that *Mineral Exhalations* may not only affect humane Bodies, as they are drawn into the Lungs with the Air they swim in, but as they insinuate themselves into the Pores of the Skin.

One considerable Objection I foresee may be made, against the Proposition I have been all this while endeavouring to render probable; namely, that 'tis scarce conceivable, that in so many Ages as *Endemical Diseases* have afflicted some Countries, the Subterraneal Matter, to which I do in great part impute some of them, should not be
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wasted and spent. I might perhaps on this occasion move a doubt, whether we have had such continued accounts of the temperature of the Air, of all the Countries where Diseases are now *Endemical*, as to know that they have been always so; and that some of those Diseases have not been worn out here or there, and some others have not of later Ages begun to appear in this or that place. But contenting my self at present to have hinted this Question, I shall not stay to discuss it; but proceed to offer three things, by way of direct answer to the Objection.

I. And first, I think it very possible, that divers Subterraneal Bodies that emit *Effluvia*, may have in them a kind of propagative or self multiplying power: I will not here examine, whether this proceed from some seminal Principle, which many Chymists and others ascribe to Metals, and even to stones, or (which is perhaps more likely) to something analogous to a Ferment, such as in

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Vegetables enables a little four dough to extend it self through the whole Mass ; or such, as when an Apple or Pear is bruise'd in one part, makes the putrify'd part by degrees to transmute the sound into it's own likeness ; or else some maturative power, whereby an inanimate Body may gradually admit of such a change, or acquire such Qualities, as may be in Mens estimate perfective of it, and perhaps give it a new denomination; as *Anana's* in the *Indies*, and Medlars, and some other fruits here in *Europe*, do after they are gathered, acquire (as it were, spontaneously) in process of time, a consistence and sweetness, and sometimes Colour and Odour, and in short such a state as by one word we call *maturity* or *ripeness* : and so some Metalline Ores, and some Mineral Earths themselves, have been observ'd by Mineralogists, to acquire in tract of time such a change, as to afford some Metal or other Body, which either it did not afford before, or at least did not afford

so copiously, or so well qualify'd. This I have purposely made out in another Paper : and the Observation particularly holds as to *Niter*, which is thought to be the most Catholick Fossile we have; and to be at least one of those Fossiles, that do the most plentifully emit *Effluvia* into the Air.

2. When I consider, that even in those Mines that are accounted deep ones, the Spades of Men are not wont to reach to the ten thousandth part of the thickness of the Earth, between its Surface, and its Centre, which yet is but its Semi-diameter; I cannot but confess, that we know very little of the Nature or Constitution of the lower part of the Terrestrial Globe; since we know little or nothing experimentally, of what lyes beneath that Comparatively very thin Crust or Scurf, (if I may so call it) that Humane Industry has been hitherto confin'd to. And upon this account I do not think it absurd to suspect, that from the lower Subter-

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raaneal Regions there may be, either continually, or periodically, emitted into the Region of Mines (if I may so call it) great store, and variety of Mineral Exhalations, which may continually repair the loss of those, that from time to time ascend out of the Fossile Region (as I may also call that of Mines) into the Atmosphere. But the things I could alledge to Countenance this Conjecture, must not be insisted on in this place. Therefore I proceed to consider.

3. That Bodies so heavy, and consequently so abundant in parts of solid matter crouded together, as Minerals, and other Fossiles are wont to be, may well be suppos'd capable, without destructively wasting themselves to emit store of such minute Particles as *Effluvia*, for an exceeding long time. This will be easily granted by him that shall consider the particulars laid together in a small Tract, that I purposely writ, about the admirable Subtilty

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of *Effluvia*. And 'twill be the more easily believ'd, if it be consider'd how long some Load-stones, sever'd from their Mine, have been kept in the Air without any notable, or perhaps so much as sensible diminution of their Virtue. And this brings into my mind what an eminent Physician, who was skill'd in Perfumes, affirm'd to me about the durableness of an Effluviating power, that was not natural to a Metal, but adventitious, and introduc'd by Art : for he assur'd me that he had a Silver Watch-case, that had been so well perfum'd, that though he usually wore the Watch in his Pocket, it continued to be well scented sixteen years. The same Person had a way of perfuming factitious Marble quite thorough, whose grateful Scent he affirm'd would last exceedingly ; and of this perfum'd Marble he presented me a Ball, which having been some months after gotten from me by a great Lady, I was disabled from observing the durableness of the fragranc^y. ¶

I might perhaps be thought wanting to my Cause, if, before I dismiss the Proposition I have been all this while discoursing of, I should not observe, that Subterranean *Effluvia* may contribute to *Endemical Diseases*, not only as they vitiate the Air, that Men breathe in, or are immediately touch'd by; but as they may impregnate or deprave the Aliments that men feed upon. For first, they do mingle themselves with the *water*, which either men drink it self alone, (as is the Custome with many Nations, and of some men in most Nations; or make of it their Bear, Ale, or other factitious drinks, prepar'd of *Water* and Barley, Oats, Rice, &c. That divers Springs, and other Waters are imbued with Mineral Corpuscles, may be judg'd by some of the Medicinal Springs: for, though divers *Acidulae* and *Thermæ* afford good store of palpable Sulphur or Salt, yet all do not; and having purposely examin'd a famous one, I could with a pair of nice Scales

scarce discover any sensible difference at all between the *Medicinal Water*, and the *common Water* that was to be met with thereabouts. And that which impregnated this, and which I found by tryal on my self, and some other Bodies, enabl'd it to work very manifestly like a Mineral Water, was a sort of Corpuscles so minute and subtile, that if the Bottles were not kept well stoppt, they would in a short time vanish, and leave the Liquor dispirited. Experience has assur'd me, that there are ways of making common water violently and hurtfully operative upon Humane Bodies, though its sensible qualities would not make one suspect any change in it: but the ill use that bad men may make of such Liquors, makes me forbear to express my self more clearly: nor is it necessary that I should add any thing to confirm the propos'd conjecture, save what may be inferr'd from these two Particulars; the first whereof is the scarce at all sensible change

change that may be made in water, and some other Liquors, that are made strongly Emetick by *Crocus Metallorum*, and by Antimony vitrify'd without addition : and the second may be taken from those *Averni*, whence there continually ascend such pernicious Exhalations, as in some places intoxicate or kill even the Birds that fly over those poysonous vents ; for if such Exhalations, or even far less deadly ones, should (as they may be reasonably suppos'd, sometimes to do) meet with either running or stagnant Waters in their ascent, there is little doubt to be made, but they will impregnate them, and make them noxious. And on this occasion we may pertinently recall to mind, what I have formerly deliver'd about a place upon the Borders of *Lancashire*, where the Water and Mud of a Ditch is so copiously impregnated with Subterranean Exhalations, (whether they be bituminous, sulphureous, or of some

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unknown kind) that they may easily be fir'd at the surface of the Water, or Earth, and made to burn like a Candle, as an ingenious man did at my Request successfully try.

But there is another account, upon which the *Effluvia* of the lower parts of the Earth may have a greater stroke in producing of Endemical Diseases; namely, as they mingle with the Water, and other Liquors that are necessary to the nutrition and growth of Plants; and, by depraving those juices, make the vegetables that are nourish'd by them unhealthy for the men that eat them, or make drinks of them: and these noxious Exhalations may be suppos'd in many places to impregnate the juices of the Earth, much more copiously than they do the running or stagnant Waters lately spoken of: because the difficulty of pervading the Earth in their ascent, may so long check them, as to make them very numerous in a small space, and perhaps make them convene into Bodies, so far of a Saline Nature as to
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be dissoluble either in common Water, or some other Subterranean Liquor; by whose help, as by vehicles, they may insinuate themselves into the roots of Plants, and be thence conveyed to other parts. Divers things might be alledg'd to keep this conjecture from being improbable, if I had leisure to insist on them: but I shall now only mention two things that on this occasion come into my mind: the first whereof is, that enquiring of a famous Chymist, who liv'd in a Countrey abounding with Mines of Vitriol, whether he did not observe, that the Oaks growing over them were more solid, or heavy, than those Trees are elsewhere wont to be; he answer'd me, that he did, and that the difference was remarkable: The other is, that the parts of some Minerals, (probably by reason of the smallness and solidity of the Corpuscles they consist of) are capable of insinuating themselves very plentifully into the pores of growing Vegetables, without being really subdu'd by what

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Philosophers are pleas'd to call the *Concocting Faculty* of the Plant; and, instead of being assimilated by the Vegetable, they retain their own Mineral Nature, and upon the recess or evaporation of the juice that serv'd them for a vehicle, may sometimes discover their being Mineral, even to an unassisted Eye. For I remember I have seen a piece of a Vine, that grew not far from *Paris*, which being broken, I perceiv'd a multitude of the internal Pores of the root, and, if I mistake not, part of the Trunk also, to be stuff'd with Corpuscles of a Marchasitical Nature; as manifestly appear'd by their Colour, and their shining lustre, and also by their weight.

There goes a Tradition among learned Men, that the leaves of Vines that grow in some places of *Hungary*, whose Mines afford Gold, are as it were gilt on the lower side, by ascending Exhalations of a Golden Nature: whether this be true or no, I shall not take upon me to determine: but I remember, that having made enquiry
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about the truth of it, of a very ingenious Traveller, whose Curiosity led him to visit heedfully those famous Mines: he told me, that he did not remember he had observ'd what is reported about the Leaves of the Vine: but he knew very well that at *Tockay* (a place that affords the famousst Wine of *Hungary*, and indeed the best I have drunk) very many of the kernels of the Grapes would appear guilt over, as it were, with leaf gold. To what has been already discours'd, may be added, that since men are not wont to feed upon either Beasts, or Birds of prey, as carnivorous Animals usually are, but upon such as live upon Grass, or Seeds, or other vegetable substances, and drink nothing but fair water; the noxious exhalations that make vegetables, and water unwholesome, may by *their* means have a very bad influence upon Sheep, Cows, Deer, Pigeons and other Animals that feed upon such deprav'd vegetables, and drink such noxious waters; and consequently may be very hurtfull to those

those men that feed upon such Animals, and may by the deprav'd aliment they afford, determine them to an Endemical Disease, such as that vitiated nutriment is fitted to produce.

Perhaps it will not seem improper to add on this occasion, that 'tis possible that in certain places the latent Minerals may be of such a Nature, as that their *Effluvia* may, instead of promoting, hinder the Production of some particular Disease, whether Epidemical or Endemical in the Bodies of them that inhabit those Places. For as Physicians observe that the more manifest morbid causes of some sicknesses, are quite contrary to those of others, so I think it not improbable, that there may also be a mutual contrariety, between those latent morbid causes, that are sent up by subterranean Agents. And therefore it need to be no wonder, if some of these should either disable those to which they are Hostile, or should at least work in Humane Bodies a great Inclination to admit their hurtfull

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Operations, which methinks those Physicians and Chymists should easily grant, who with a boldness that I do not applaud, prescribe Amulets, wherein Arsenick, or some other poysonous Drug is employ'd, as preservatives from the Plague, against which, I doubt the chief Succours they afford, proceeds from the Confidence or Fearlessness they give those that wear them. But to return to our subterranean *Effluvia*, since there are divers whole Countries, or lesser places, that are either altogether, or in great part, free from this or that particular Disease; as in several parts of *Scotland* from Agues, especially if I mistake not Quartans, are very unfrequent, insomuch that a learned Physician answer'd me, that in divers years practice he met not with above three or four, and in several large Regions of the *East-Indies*, notwithstanding the excessive heat of the Climate, the Plague is very rare: since (I say) these things are so, it seems not altogether improbable that the subter-

terraneal steams may contribute to this advantage, by impregnating both the Air, the Earth, and the Water, with Corpuscles endow'd with Qualities unfriendly to these Diseases, which seems to be somewhat the more credible, because it has been observ'd that some vast Tracts of Land will neither breed nor maintain venomous Creatures, as is undoubtedly believ'd of the whole Kingdom of *Ireland*, where I confess I neither did see any alive, nor met with any other that did; for as to Spiders, though they breed in that Countrey, where I have seen many of them, and sometimes even upon *Irish* Wood, yet they are unanimously believ'd not to be poysonous there: And some Writers tell us, how truly I know not, of some other Countries, to which they affirm the like Privilege to belong. But there is one instance afforded us by *Begninus*, who travel'd much to visit Mines, which if it be strictly true, is very notable for my present purpose. *Dignum admiratione est*, says he, *quod quamvis in vicinia Hydrie*
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Comitatus Gloriciensis, ubi reperitur copiosè & singulis ferè annis Lues pestifera grassatur, illa tamen semper immunis ab hac manere soleat, idque viri pro- vectæ ætatis se observasse & à majoribus suis accepisse, mihi sanctè confirmârunt. To which I should add the Testimony of the Learned *Michael Mayerus*, who pronounces Mercury to be an *Alexipharmacum* against divers Diseases, and particularly the Plague, if I did not suspect by his way of mentioning this last Disease, that he but borrowed his *Encomium* of Mercury from *Begninus*. But however; what has been related, has invited me to consider, whether there may not be some virtue, as well as some danger, in Amulets of Quick-silver that are by many extoll'd against the Plague. But this onely upon the bye.

PROPOSITION III.

It is Likely, that divers Epidemical Diseases are in great part produc'd by Subterranean Effluvia.

I Am very well aware, that divers Diseases that extraordinarily invade great numbers of people at the same time; (and were therefore, by the Greeks called *Epidemical*) may be rationally refer'd to *manifest Intemperatenesses* of the Air, in point of Heat, Cold, Moisture, or some other *Obvious Quality*. And therefore the *Proposition* speaks but of *some Epidemical Diseases*, and imputes those it speaks of to *Subterranean Effluvia*, not as *total*, but as *partial*; and sometimes as *principal, Agents* in the production of them.

In favour of the propos'd Conjecture thus explain'd, I shall offer two things to Consideration.

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I. And first, it seems not very improbable, that divers of those *Morbifick Excesses* (especially if they be *sudden*) that are observ'd in the *Air*, may proceed from the unusually copious ascent of hurtfull *Exhalations* that mingle with the *Air*, and diffuse themselves through it. We are greater Strangers than we commonly take notice of, to the *Subterranean* part of the Globe we inhabit: and if I had leasure, and thought it necessary, I could shew, that there are a great many odd and surprizing things to be met with in the Structure and disposition even of those parts of the Earth, that lie but a little way beneath the surface of it, and partly have been, and partly may easily enough be, actually penetrated by the industrious Labours of men. And as for the deeper *Subterranean Regions*, we are so much more unacquainted with them, that we are scarce fit so much as to *conjecture*, how far they extend, or

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what kind of Materials they contain, and what is the gross, and (if I may so speak) the Mechanical Fabrick of the greater Masses, whether solid or fluid, they consist of: And least of all can we determine what Motions, whether periodical, or others, these Masses, or other Portions of deeply lodg'd Matter, may have.

On such grounds as these, I conceive it possible, that, among the many and various Effluviating Bodies, that the terrestrial Globe may conceal in its Bowels, there may be some, whose reeks ascending plentifully into the Air, may occasion in it an excess of Heat, Cold, Moisture, thickness, or some other manifest Quality. So that sometimes (not to say many times) even those manifest Intemperatenesses of the Air, to which an Epidemical Disease is wont to be wholly imputed, (though perhaps not very justly) may in part proceed from Subterranean Bodies; for I elsewhere shew, that these by their Conflicts, or Mutual Actions on

one another, may excite great and sudden Heats, and on that account send up such copious Steams into the Atmosphere, as may produce there sudden and excessive Heats, Lightnings, Thunders, &c. And I shall now add (what perhaps will appear somewhat strange) that I think sudden and unseasonable Refrigerations of the Air, may proceed from the action of Subterranean Bodies upon one another: for Tryal purposely made has inform'd me, that there are certain Minerals, whereof some may be employed in their crude Simplicity, and the other requires but a slight Preparation, such as it may have in the Bowels of the Earth; which Minerals being put together, will produce by their Reaction an intense degree of Cold, not onely as to sense, but when examined by a seal'd Weather-glass.

The Changes of the Air that produce *Epidemical Diseases* are sometimes so great and sudden, that they cannot, in my Opinion, with
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probability be imputed to the action of the *Sun*, or the *Moon*, (which are causes that act in too general, and too uniform a way, to have those *particular* and *anomalous* Effects attributed to Them;) as probably as they may be to *Subterraneal* Bodies, that often act with more suddenness and impetuosity, and without any regularity, at least that is known to us. The difference we find in Seasons, that bear the same name, and should be alike in temperature, is oftentimes very great, and sometimes also very lasting. It is proverbially said in *England*, that a *Peck of March Dust is worth a King's Ransom*: So unfrequent is dry Weather during that Month, in our Climate. And yet in some years, and particularly the last, 'twas a rare thing to have a shower either in *March*, *April*, or *May*, sometimes in the Month last named, there are Heats greater than in the Dog-days of that same Year; though usually here in *England*, divers Mornings of that Month are

cold, and some of them frosty. And now and then I have observ'd in the same Months and Days, at no great distance from one another, that the Weather has been sultry hot, and has also produc'd a great Snow. We have seen Summers like that which is remember'd for the Siege of *Colchester*, that for almost the whole Season, were more dark and rainy, than several Winters have been observ'd to be. To which purpose I remember, that when I was about to write the History of Cold, I was fain to watch almost a whole Winter to find two or three frosty days, to make an Experiment or two I had need of, that requir'd not a Cold that was either lasting or very intense. But Instances of this kind are so obvious, to those that are at all heedfull Observers, that I may safely pass them by, and inculcate that the Sun being in the same Signs, at the same Times of the Year, it does not appear, how He should produce so great a disparity

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of the temperature of the Air in Seasons of the same denomination; (as the Winters or the Summers of differing, and yet perhaps immediately consecutive, Years.) And therefore I do not so much wonder, that many Learned Writers fly to Astrology for an account of these irregular *Phænomena*, and ascribe them to the influences of certain Stars; notwithstanding what divers eminent Philosophers, and some great Astronomers too, have said to prove the vanity of Judiciary Astrology.

I shall not now stay to discuss the Question, *whether the Stars have any influence distinct from their Light and Heat*: because, my Opinion about it being somewhat peculiar, I have discoursed of it in a Paper by it self. But this I shall now say, that the fixt Stars being but general, and (if I may so speak) indefinite Agents, almost unimaginably remote from us, 'tis nothing near *so* likely that such Effects as (besides that they happen very suddenly and irregularly)

ly) are oftentimes confin'd to a Town, or some other narrow Compass, should be produc'd by certain Stars: *as* that they should be so by Subterranean Bodies, which are near at hand, of very various natures, and subject to many irregular and differing Motions, commixtures, reactions, and other alterations. I have known a great Cold in a day or two invade Multitudes in the same City, with *violent*, and as to many Persons *fatal* Symptoms; when I could not judge, (as others also did not) that the bare coldness of the Air could so suddenly produce a Disease so Epidemical and hurtfull: and it appear'd the more probable, that the cause came from under ground, by reason that it began with a very troublesome Fog.

That there may be many Subterranean Bodies, which by their commixtures may produce a sudden Heat, will be easily granted by those that know, (what I elsewhere purposely make out) that there are Subterranean

neal *Menstruums*; and are acquainted with Chymical Operations, such as the great effervescence made, when Oil of Vitriol is put upon filings of Iron, or Spirit of Niter upon Butter of Antimony; to which I might add many other of the like kind that I have tryed, as when Spirit of Niter is put upon filings, either of Iron, Copper, or Tin, or upon crude Quicksilver; which I shall content my self to have nam'd, because I have another Instance that comes closer to our present purpose. For whereas I have shewn above, that there is in many places great store of Marcasitical matter beneath the surface of the Earth, and sometimes very near it; I shall now add that I have purposely tryed, that putting a little Spirit drawn from Niter, (with which Salt the Earth in many places abounds) or a little Oil of Vitriol, upon powder'd Marcasites (which being hard Stones are more difficultly wrought upon, than many other Subterraneous marcasitical Bodies

dies of a looser texture) there presently ensued a strong reaction between the Liquid and the Solid Bodies, whereby was produc'd much heat, not without visible fumes, and Strongly Scented, though not visible, Exhalations. And such kind of Odorous *Effluvia* were emitted, upon the putting a little Spirit of Salt upon our Powder'd Marcasites. And because Sulphur is a mineral that (either pure, or copiously mix'd with others) is to be plentifully met with in the Bowels of the Earth, and in many places burns there, I shall add, that I have found acid Spirit of Sulphur (made the common way) to work sensibly upon marcasitical matter, hard enough coagulated. An experienc'd German Chymist relates, that in some parts of his Country he met with Vitriol Stones, or Marcasites, that, by the action of mere common Water resting a competent time upon them, will grow so hot as to enable the Liquor to retain a sensi-

sensible Heat, when it had pass'd a pretty way from them. And, as I elsewhere shew, that many Accidents may occasion the breaking out of Waters, or the change of their course in Subterranean Places; So, that common Water may produce in a very short time considerable degrees of Heat in Mineral Bodies, may appear by mixing with two or three pounds of fine Powder of common Brimstone a convenient quantity, (for now I remember not well how much I took) of filings of Iron, for this mixture being thoroughly drench'd with common Water, did in a short time grow intensely hot, and send up such a thick Smoke as good quicklime is wont to doe, whilst men Slake it with Water.

It is observable to our present purpose, what account was given me by a Domestick of mine, that liv'd in the North part of England, of a certain Mineral Groove which he had often occasion to resort to: for, when

when I ask'd whether the Damp that place was molested with, did frequently recurr; he answer'd me, that at the time he was there it would annoy the workmen, (if they did not take good care of themselves) more than once in one day. And by Enquiries that I made of others that were conversant in Mines, I learn'd, that in divers places they were molested with Damps, that came not at stated Periods, but irregularly; sometimes with much greater, and sometimes with far lesser, Intervals between them: the times of their duration being also not seldom unequal. So that, supposing such noxious *Effluvia* to be plentifully emitted from the lower parts of the Soil, it need be no wonder, that an *Epidemical* Disease should be rise in this or that particular Town or part of a Country, without spreading much farther; and that it should begin suddenly in places where it was not expected: for, besides that these swarms of *Effluvia*,
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being produc'd by casual concourses of Circumstances, may oftentimes be excited, and invade this or that place, without giving the Inhabitants any warning, besides this, I say, 'tis not always necessary that these noxious *Effluvia* should be generated just under the places they molest, since the motion of the Air, especially when the Wind sits favourably, may suffice to carry them to the Town or other place that feels their ill effects: and yet they may seem to be almost confin'd to those places; sometimes because the neighbouring places are not inhabited enough to make their ill qualities taken notice of; but more frequently because, by being diffus'd thorough a greater tract of Air, they are more and more dispers'd in their passage, and thereby so diluted (if I may so speak) and weakn'd, as not to be able to doe any notorious mischief.

And here I Consider too, that 'tis not always necessary that the harm that is done by these morbid
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Constitutions of the Air, should proceed onely or precisely from these Subterranean Exhalations we are speaking of, by virtue onely of their own qualities, which they bring with them from under ground. For 'tis very possible, that these *Effluvia* may be in their own nature either innocent enough, or at least not considerably hurtfull, and yet may become very noxious, if they chance to find the Air already imb'd with certain Corpuscles fit to associate with them: for, though these sorts of Particles were perhaps neither of them a-part considerably hurtfull, yet there may from their Combinations result Corpuscles, of a new and very morbisick nature.

This may be somewhat illustrated by considering, that the spirituous steams of Salt-peter are not wont sensibly to work on Gold, nor yet the spirituous Parts that the Fire raises from *Sal-armoniac*; and yet when these two sorts of Particles convene, there results from their Coalitions
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certain Corpuscles of a new nature, that compose the Liquor Chymists call *Aqua Regis*; which by its fretting quality corrodes and dissolves Gold. By Analogy to this we may conceive, that sometimes the Subterranean *Effluvia* may find the Air already impregnated with such Corpuscles, that by associating themselves therewith they may compose Corpuscles far more capable, than themselves were whilst apart, of having ill Effects upon the Mass of Blood, or some determinate Parts of Humane Bodies, and consequently of produceing Diseases there.

And this Instance may appear the more apposite; because it may be said, that *as*, though Silver and Gold, and Diamonds and Rubies, &c. be put together, and *Aqua Regis* be pour'd upon them, it will leave all the rest uncorroded, and fall onely upon the Gold; so the newly produc'd Corpuscles that I have been speaking of, whether breathed in with the Air in Respiration,

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or carried up and down by the Bloud, or other Liquors of the Body, may pass by other parts of it without doing them any sensible harm, and attacking this or that determinate part, produce there some Disease such as the fabrick and situation of that part peculiarly dispose it to be affected with.

And I shall add on this occasion, that in our *Hypothesis* we may render a probable reason, why in some Epidemical Diseases, some persons may escape much better than other, that seem likely to be, at best, as obnoxious to them, without a recourse to the peculiar Constitutions of the Bodies of differing Persons; for it may be conjectur'd, that the noxious Corpuscles that infest the Air, may (especially in windy weather) be very unequally dispers'd through the Air, and many fly in far greater or lesser numbers within equal spaces of Air; and consequently the Persons, that have the ill luck to be in the way of the more

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numerous swarms of morbidick Corpufcles, may be much more prejudiced by them than others, though of weaker constitutions, who happen to be attack'd but by few of them.

On which occasion, I remember, that a great many Trees in some Land that belongs to me, having been suddenly much endamag'd by a wind, that was not able to doe it by it's bare strength; I had the curiosity to view somewhat heedfully a Tree that stood in the Garden, and perceiv'd that all the considerable mischief was done to that side of the Tree, which respected the corner whence the hurtfull Wind blew, the Leaves of the other side continuing fresh and verdant, as being by the other part of the same Tree fence'd from the Wind: and it was farther observ'd, that even the expos'd side of the Tree was not every-where endamag'd; for there were divers parts, where the Leaves continued sound and green, though neighbouring Leaves were some more, some

less (for all that were prejudic'd were not totally) blasted: the sound Leaves and the discolour'd being so odly mingled, that I conjectur'd the cause of the mischief to have been this; that some Arsenical or other corrosive or poisonous Exhalations, being suddenly emitted from the Subterranean parts into the Air, were by the Wind they chance to meet with there, hurry'd along with it, and blown against the Bodies that stood in it's way, moving in the Air, like Hail-shot discharg'd out of a Gun, here in a closer, and there in a more scattering order, so that as more or fewer of them happend to fall upon the same Branch or Lease, they left more, or less marks of their passage, by destroying the texture and colour in the Leaves or parts of them they chanc'd to beat upon. And this may possibly be the cause of some of those sudden and sometimes fatal Effects, that I have known in some places the people talk much of, complaining, that such a one had his
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Eyes, or his Face, or onely one side of it blasted, by a malignant Wind, of which I thought I saw an Example in a Domestick of my own, whilst in such a Wind he was riding after me, who (thanks be to God) had no such mischief done me.

But the Vulgar have entertain'd such strange Conceits and Stories about these Blastings, on which account some of them say that Men are *Planet-struck*, that the fabulous things mingled with those that are possible, have made intelligent Persons reject them all.

One thing more I shall take notice of in favour of our *Hypothesis*, which is, that it well agrees with what has been observed, not without some wonder, of the very short duration of some Epidemical Diseases, in certain Times and Places. For this may proceed from hence, either that all the Morbifick Expirations ascended into the Air almost at once, or at least within a short time, and so were easily spent, that is by diffusion or

dispersion so weakned, as to be disabled from doing much mischief: or else the Subterranean Commotion that produc'd them may pass on from one place to another, and so cease to afford the Air incumbent on the first place, the supplies necessary to keep it impregnated with noxious Exhalations. And it agrees well with this Conjecture, that sometimes we may observe certain Epidemical Diseases to have as it were a progressive Motion, and leaving one Town free pass on to another. Of which some Observations that I have made, encline me to think, that if Physicians would heedfully mind it, they might take notice of several Instances.

One thing more may be added, as consonant to our *Hypothesis*; namely, that sometimes an Epidemical Disease ceases in this or that place, almost as sudden as it invaded, or at least in a much shorter time than Physicians expected. For according to our *Hypothesis* it may well happen, that

that after one sort of Exhalations, whose peculiar Qualities make them Morbifick, have deprav'd the Air incumbent on a particular place; there may by a new or farther Commotion of Subterranean Bodies, be sent up into the Air store of Expirations of another kind, which meeting with those that formerly impregnated it, may either precipitate them, and so free the Air from them; or by other operations on them, and sometimes even by Coalitions with them, so alter their nature as to disable them from doing any farther mischief.

This I shall illustrate, if not confirm, by that very remarkable *Phænomenon* that is yearly observ'd at *Grand Cairo* in *Ægypt*; for, (though I know not whether or no the Corpuscles that produce it arise from under Ground, the affirmative part of the Question being not improbable) it appears, that by the intermixture of adventitious Corpuscles, with the formerly Pestilential Air, 'tis so alter'd and

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corrected, that within one day or two, if not within a lesser compass of time, there is a stop put to the progress of the Plagues; that in that favourable time of year, namely about the middle of Summer, scarce ever misses of raging in that populous City: and, which is more admirable, these sanative Corpuscles (if I may so call them) operate so powerfully, that of those that are already seiz'd by that fatallest of Diseases, the *Plague*, few or none die of it, after once these Antidotal Particles have sufficiently impregnated the Air. I confess so great and sudden a change is very wonderfull, and I should scarce think it credible, if I had not had the means and curiosity to enquire about it of divers persons, some of them very intelligent, that either curiously visited, or also made some considerable stay in, that great City; and found them agree in the main about the truth of the matter of fact; which is much confirm'd to me by so eminent a Testimony as that of the
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learned *Prosper Alpinus*, who for several years practis'd Physick in *Grand Cairo*, and as an Eye-witness delivers what he relates more authentically, as well as more particularly, than any I have met with. And, though he endeavours to give several reasons of this strange and sudden cessation of the malignity of the Plague, yet I doubt they are not sufficient for so wonderfull an effect; unless we take in some new Exhalations, that then impregnate and correct the Air.

And we shall scarce doubt of the great interest these have in the effect produc'd, if we give credit to what the recentest Writer I have met with of *Voyages into Egypt*, has lately publish'd about the annual Pestilence at *Grand Cairo*, a City he much frequented. This Authour, in the account he gives of the present state of *Egypt*, relates that a little after the middle of our *June* (and usually upon the very seventeenth day) there begin to fall towards the last quarter of the night,
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near the morning, certain drops of a kind of Dew, which causes the River to be fruitfull, and purifies the Air from all the Infection of *Camsims*, by which I presume he means the *Pestilence*: for after some lines interpos'd he subjoins, *The Drops or Dew purifies the Air, for as soon as it falls the Plague ceases to be mortal, none dies of it; the Air is wholesome, all Distempers cease, and if any person grows sick, he never dies.*

And then, he adds, *This Dew gives life to every thing; and when it falls upon the Wheat, it causeth it to continue many years without corruption or Worms, and is far more nourishing than that Corn on which it never falls.* For this cause they never house the Corn of the Grand Seignior in the Barns, till this Dew is fallen upon it, that it might keep the longer without Worms.

As well this Conjecture, as some other things deliver'd here and there in this Paper (about the *Salubrity of the Air*,) may probably gain the
more

more credit, if I here subjoin what I learn'd by inquiry from a very ingenious Gentleman, who was owner of one or more of the Mines, that afford the *Phænomenon* I am to mention. Which is this, That in the Tin-mine Countreys in *Devonshire*, it sometimes happens, (as perhaps I may have elsewhere noted to another purpose,) that upon a sudden, a Spot of ground, and that not always narrow, will be as 'twere blasted by the ascending hurtfull Fumes; inso-much that not onely the Grasse, Fern and other more tender Vegetables, will be turned black, and as it were burnt or scorched up; but now and then Trees also, without excepting Oaks themselves will be blasted and spoil'd by the powerfull Operation of these subtil and poisonous *Effluvia*.

It will probably be here expected, that among the Epidemical Diseases that our *Hypothesis* derives from Subterranean *Effluvia*, I should particularly treat of the cause of *Pestilential*

lential Fevers, and the *Plague* it self. But, though some such *Fevers* may not improbably be in great part imputed to the noxious *Expirations* of the *Globe* we inhabit; yet, as to the true *Plague* it self, I freely confess I am at a loss about it's *Origine*.

The sacred *Writings* expressly teach, that some *Plagues*, and particularly that which in *David's* time swept away in three days 70000 Persons, have been in an extraordinary manner inflicted by God. And to me it appears either scarce possible, or far more difficult than those that have not attentively enough considered the matter, are wont to think it; To deduce the abstruse *Origine*, strange *Symtomes*, and other odd *Phænomena* of some *Plagues* that are recorded in *History*, from merely *Corporeal Causes*.

On the other side, it seems unphilosophical, and perhaps rather seems than is very pious, to recur without an absolute necessity to *Supernatural*

tural Causes, for such Effects as do not manifestly exceed the power of Natural ones: though the particular manner of their being produc'd, is perchance more than we are yet able clearly to explicate. And I think it the more questionable, whether all Plagues are Supernatural Exertions of God's Power, and Wrath against the Wicked, because I observe that *Brutes* (which are as well incapable of moral Vice, as moral Vertue) are yet oftentimes subject to *Murrains*, such as may without incongruity be lookt upon as the *Pestilences of Beasts*. And 'tis the less likely, that these sweeping and contagious Maladies should be always sent for the punishment of impious men, because I remember to have read in good Authours, that, as some Plagues destroy'd both Men and Beasts, so some other did peculiarly destroy Brute Animals, of very little consideration or use to Men, as Cats, &c.

Upon these and the like Reasons I have sometimes suspected, that in the Controversie about the Origine of the Plague, namely, Whether, it be Natural, or Supernatural; neither of the contending Parties is altogether in the right: since 'tis very possible, that some Pestilences may not break forth, without an extraordinary, though perhaps not Immediate, interpolation of Almighty God, provok'd by the Sins of Men: and yet other Plagues may be produc'd by a Tragical concurrence of merely Natural Causes.

But *though* the difficulties that incumber each of the opposite Opinions, keep me both from Dogmatically asserting, that All Plagues have a Supernatural Origine; and from denying that Any have it: *yet*, to say something on such an occasion, though I can speak but very hesitantly, I shall venture to add, that, whether or no the true Plague be said to descend to the Earth from a higher Sphere than that

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of Nature; yet its Propagation and Effects are (at least for the most part) carry'd on mainly by a malignant disposition in the Air; without which some Plagues could never have been so catching as they were, nor so suddenly mortal; and that in divers Pestilences this malignant Disposition in the Air, may probably be in great part imputed to some kinds of Subterranean Expirations, I am prone to think; and that chiefly upon two Accounts.

The *first* thing that induces me to this Conjecture, is, that not any of the several Causes to which the Plague is wont to be imputed seems to me to be sufficient. Those that fetch it from the malevolent aspects and influence of the Celestial lights, besides that they suppose some things very difficult to be prov'd, have recourse to Agents too remote, too general, and too indeterminate, to be acquiesc'd in as the Causes of such particular Symtomes and *Phænomena*, as oftentimes accompany Pestilences.

And as for those other Sects of Physicians that confidently derive the Plague, some from Internal Putrefaction, and others from excessive Heats, noisome Stinks, Corrupt aliments, and such other Celebrated Causes; though each party alledges plausible Reasons for its own opinion, yet their objections against their adversaries are much stronger than their arguments are for themselves. And the Learned *Diemer-broeck*, though his own Hypothesis seem to be more Theological than Philosophical, has much enervated the Arguments brought for the several opinions lately nam'd, and by him dissented from.

The Reasons he employs to refute all the receiv'd opinions about the Origine of the Plague, except his own, are divers of them worthy of so learned a man; to whom, though I had leisure to transcribe them, I should refer the Curious: my present design being onely to deliver some few things that seem more fa-

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vourable to my Conjectures, than to his Opinion, and were suggested to me, partly by my own Thoughts, and partly by the informations, that, to examine those Thoughts, I procur'd by consulting some uncommon Authours, and asking Questions of great Travellers and Navigatours. By this means I came to learn, that divers great Countries are usually free from the Plague, that according to the vulgar *Hypotheses*, ought to be as much subject to it, if not more, than *England, France, Italy*, and those other parts of *Europe* and *Asia*, where that fatal Disease rages from time to time in the parched Regions of *Africk*, to which the Excessive Heats would make one expect, that the Plagues should make far more frequent visits than to our temperate European Countries; *Leo Africanus* informs us, that some parts are so seldom afflicted with that dreadfull Disease, that it usually spares the Inhabitants 29, or 30 years together. And he expressly records, that in *Nu-*

midia it self, (if I much misremem-
ber not the Countrey's name, not-
withstanding the raging heat of the
Climate, the Plague is wont to be pro-
duc'd but once in a hundred years.

* Purchas's Pil-
 grimage, lib. 6.
 cap. 13.

Our * Purchas informs
 us that *in the Land of*
Negro's it is not known
 at all. And to omit
 what some Travellers and Naviga-
 tours relate of *Japan*, as if it were
 seldom or never invaded by the Pestil-
 lence; I do not remember that in
New England, which contains a
 great extent of Land, though I have
 had both Curiosity and opportunity
 to inquire after the Diseases of that
 Countrey, I ever heard the English
 take any notice of the Plague,
 since their settling there above three-
 score and ten years ago. And as for
 the *East Indies*, Sir *Philibert Vernatti*,
 a *Virtuoso* of great fame and authori-
 ty at *Batavia* where he resides, in
 his ingenious Returns to the Queries
 sent him by the *Royal Society (of*
Naturalists) answers thus to the fif-
 teenth.

teenth. [*Pestis morbus est Indiarum Incolis incognitus*] The Plague is a Disease unknown amongst the Indians. And of the Countries that lie yet more remote, as the great Empire of China, and the Kingdoms of Tunquin, and of Cochinchina, that great Traveller Alexander de Rhodes, who spent 30 years in those parts, affirms, that the Plague is not so much as spoken of there. And yet the same Jesuit does, upon grounds probable enough, estimate the number of the people of China alone to be two hundred and fifty millions; [a number I take to exceed by far that of all the Nations of Europe.] Now when I consider, how vast Tracts of Land are compriz'd in those Countries, some of which the Plague does not at all, and others but exceeding unfrequently, invade; this Immunity seems to me very unfavourable to most, if not all, the opinions receiv'd among Physicians, as also that of Diemerbroeck himself who derives the Plague from a Supernatural Cause,
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the wrath of God against the sins of men. For in Regions of such extent, and divers of them very populous, which are seated under very differing Climats, and which are some of them inhabited by Nations, that make war with numerous Armies, fight bloody battels, leave heaps of unbury'd Bodies expos'd to the putrefying heat of the Sun ; are sometimes forc'd, as well as others to live upon very unwonted and unwholsome foods ; that worship stocks and stones, and beasts, and some of them Devils, whom they know to be such ; that are at least as guilty as Europeans, of Affasfinats, Poisonings, Rapes, Oppression, Sodomy, and other crying Sins : in these Regions, I say, 'tis not imaginable but that great Intemperatures of the Air, especially, in point of Heat, Stench of dead Bodies kill'd in fights, unwholsomness of Aliments, malevolent aspects of Celestial Bodies, high provocations of the divine Justice, and in short, all the Causes, to one or other of which the several

ral parties of Physicians are wont to refer the Plague, should be wanting any more than in our *Europe*; and yet the Plague which is presum'd to be the Effect of one or other of those Causes, is not here observed to be produc'd.

I know that it may be said, that the Historical things I have been reciting, do not onely oppugn the several receiv'd Opinions of Physicians about the cause of the Plague, but disfavour my Conjectures too. But if this be said, I desire it may also be consider'd, that my Judgment about the Plague consists of two Parts; *One*, that 'tis exceeding difficult to assign the true and adequate Cause of the Origine of the Pestilence; and the *Other*, that whatever be the Cause of its First Eruption, its Propagation and divers of its Symptoms, may be probably enough refer'd to the depravation of the Air by Subterranean Steams, and their Effects. If this be duly consider'd the Historical Observations will

will appear not to overthrow the *First* member of our Hypothesis, but rather to confirm it: and 'tis upon this account that I have mention'd them in this place. And as to the *Second* member it may be said, that since in the East *Indies* and the other Countries, I have nam'd, as privileg'd from this raging Disease, it is not observ'd to break out: as it cannot be said that Subterranean *Esfuvia* do in those Countries promote the Propagation of it; so it cannot be prov'd that they could not doe it, in case the Plague were begun by other Causes. But in regard I think it not improbable that sometimes the Plague is not onely fomented but begun by noxious Expirations of the Terrestrial Globe, I shall add that this supposition, though I confess it be somewhat disfavour'd by some of the lately mention'd Observations, yet is not absolutely inconsistent with them. For First, it may be said that some of the Countries I speak of, may be destitute of those

those noxious minerals to which we impute some Plagues, it holding true in Minerals as well as in Plants. *Non omnis fert omnia tellus*, and to omit what I have not without some wonders observ'd, of the Limits of differing sorts of Mines and Mineral Veins in very bordering parts of the same tract of Land, I cannot but here take notice, that though Sulphur be in many Countries usually found, and that in plenty where there are other Metalline Veins, in-somuch that Chymists make it one of the three Principles of all Metals, yet in the Mines of *England* more strictly so call'd, I do not remember I ever met with so much as an Ounce of Native Sulphur, and I could not find by divers Mineralists, of whom I purposely ask'd the question that they had met with any among the various Mines they had frequented. It may also happen that there may be hurtfull Minerals in a Countrey, and yet not capable of often producing or promoting Pestilences there,

there, even upon moderate Earth-quakes. For 'tis possible that these Orpimental or other Noxious Minerals may have their Beds or Veins lying so deep in the Earth, that they are not ordinarily able to send up *Effluvia*, strong and copious enough to make a Pestilential depravation of the Air, and even in lesser Earth-quakes the commotion or agitation of the ground, especially if the Earth-quakes proceed (as one may suspect that divers of them do) from the sudden fall of ponderous Masses in the hollow parts of the Earth and the shakings of the ground thereby produc'd, and sometimes spreading far, may not reach so far downwards as much to affect these very deep Mines, and yet some other more violent Earthquakes, may affect even these; upon which ground one may give some tolerable account why the Plague in some parts of *Africk* has been observ'd to rage but once in thirty or once in an hundred years; for there may be periodical

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Paroxysms, if I may so call them, or grand and vehement Commotions in Subterranean Parts, though men have not yet, for want of sufficient Longevity or Curiosity observ'd them. On which occasion, I remember that a late judicious French Historian recounts that in part of the last age, and part of this, a very pernicious Disease of the nature of a Colick raign'd in *France* every tenth year for a long tract of time.

And the Experienc'd * *Platerus* relates, that at *Basel*, * Lib. 2. P. M. 323. where with great success

he practis'd Physick fifty six years, the City was afflicted with furious Plagues once about every tenth year for seventy years together, of each of which Pestilences he gives a particular account in his usefull observation. It may also farther be said, that those Exhalations in the East *Indies*, &c. that would otherwise be pestiferous, may be corrected by other Expirations that may be either of benign nature, or of such a nature

ture, as though noxious in themselves, may fit them by combining with those that would be pestiferous to disable them to be so, as I elsewhere observ'd out of *Beguinus*, that a Countrey abounding in veins and masses of Cinnabar, which is the Ore of Quicksilver, was preserv'd from the Plague, when the neighbouring Regions were wasted by it; and I shall illustrate this matter somewhat farther by taking notice, that though Corrosive Sublimate be so mischievous a Mineral Composition, that a few grains may kill a man, yet the fumes of this combin'd with those of *Crude*, common Quicksilver, which are themselves unwholesome enough, make *Mercurius dulcis*, which is a mixture so innocent, that being well prepar'd, and well administred, it is both safely and usefully given even to Children.

If what has been said will not suffice, I shall propose another possible way of accounting for the immunity of some Countries from the Plague.

Plague. For one may conceive that in such Regions the Soil, and other assisting Causes may constantly produce in the Air such a Constitution as is found in the Air of *Egypt*, during the time of the increase, and overflowing of *Nile*, which usually lasts every year for several weeks, for during this time the Air is so antipestilential, that not only the Plague does not make a new Eruption; but is either wonderfully check'd or quite suppress'd in those houses that it has already invaded, so that its mortal infection reaches no farther, and that it may not be thought incredible that some Countries may have, if I may so speak, an antidotal Nature, in reference to some pernicious Evils, I shall represent that there are some whole Countries which are privileg'd from producing Vipers, Toads, and other venomous Creatures, as is vulgarly known concerning *Ireland*, where I could never see any such, nor find by Enquiry of either the Natives, or English In-

F habitants,

habitants, that they had met with any in that Kingdom, where 'tis an uncontroll'd tradition, that if Poysonous Creatures have been carefully brought there from other Parts, they have died almost as soon as they came thither. There are some other Islands to which a like hostility to venomous Animals is ascrib'd: and as it seems not impossible that some Countries should have a Soil that so impregnates the Air as to make it suppress or quite enervate many differing sorts of Poysons, so others may by their Constitution be qualify'd to master or resist poisonous Expirations or wandering Corpuscles that elsewhere are wont to produce the Plague. And this may suffice for the first thing whereon we ground our Hypothesis.

The Second thing that invited me to the above propos'd Suspicion or Conjecture, is, That it affords a not improbable account of some considerable things, relating to the Pro-

Production and *Phænomena* of the
Plague.

(1.) As *First*, 'tis observ'd that sometimes the Plague breaks out, when there has not preceded any such immoderate distemper of the Air, or any casual Enormity capable of producing so great and anomalous an Effect. Nay, which is more, it has been observ'd, that very great and unusual intemperatenesses of the Air have several times happen'd, and divers notable and threatening Aspects of the Stars have been noted by good Writers without being follow'd by the Plague. The

celebrated * *Fernelius* relates, that near the time he writ this Observation,

* *De abditis
rerum caus.
lib. 2. c. 13.*

that Year, which of all those that had pass'd in the memory of Man, was all the World over the most immoderately hot, and was yet most healthfull. And the same Authour reports the Plague to have begun in the midst of Winter, and to have gone off in Summer, and that several

ral times ardent Summers have been altogether free from the Plague : which I also have noted to be true. *Johannes Morellus* observes, that in his Countrey after a dry Winter, and wherein the North Wind reign'd, though it were succeeded by a most temperate and healthfull Spring, yet this brought in the Plague, and that, when the North Wind was predominant and the Air pure and sincere. Which I the less scruple to believe, because I observ'd something very like it in the Constitutions of the Air, that preceded and accompany'd the dreadfull *London* Plague that broke out in the year 1665. Which *Phænomena* much disfavoured their Opinion that impute the Plague to the excesses of the manifest Qualities of the Air; but are agreeable to our *Hypothesis*, since by what has been formerly deliver'd, we may gather that Noxious Subterranean Fumes may be suddenly, and without any warning belch'd up into the Air, and, by depraving it, produce fatal

fatal Diseases in many of those that are constantly surrounded by it, and draw it in, almost every moment, with their breath.

Of the deadly Hurtfulness of divers Subterranean Expirations, at their first Eruption, there are many Histories extant in approv'd Authors: And we have observ'd Instances of that sort, in the Times and Countries we live in. But, because all Poisonous, and even mortal, Exhalations are not therefore truly Pestiferous, but may, like many other Poisons, kill the Persons they immediately invade, without qualifying them to infect others; I shall add a Passage out of that Excellent Historian "*Monsieur de Mezeray* who relates in the life of *Philip de Valois*, that the Plague that happened in France in the Year 1346. was so contagious and destructive, that scarce a Village, or even a House, escap'd uninfected by it. He adds, that this Pestilence, than which none had been observ'd more furi-

ous and spreading, began two years before in the Kingdom of *Cathay*, by a vapour that was most horribly stinking, which brake out of the Earth like a kind of Subterranean fire, consumed and devour'd above 200 Leagues of that Countrey, even to the very Trees and Stones, and infected the Air in a wonderfull manner. *From Cathay*, say's he, *it pass'd into Asia and Greece, thence into Africk, afterwards into Europe, which it ransack'd throughout.* Other Instances, of Pestilences begun by noxious Subterranean Fumes, I

See *Diemerbroeck de Peste, lib. 1. cap. 8.*

have met with in good Hours; but cannot now recall the Particulars to mind, and therefore shall pass on to the second Observation.

(2.) In the next place then; whereas 'tis noted by diligent Observers, that there is a wonderfull diversity in several Countries, and even in the same Countrey at several distant times, of those raging Diseases, that Physicians agree in calling the

the Plague, (whence it happens that such Medicins or Methods of curing as are in one Plague succesfull, as Phlebotomy, Purging, &c. do oftentimes in another prove dangerous, if not mortal) whereas (I say) this great variety has been observ'd in Plagues; it may be fairly accounted for, by the great number and diversity that has been actually found, or may be reasonably suppos'd, in the numerous Minerals, and other Bodies that nature has lay'd up in the Subterranean Regions: especially if we consider, that the number of such Bodies may be much increas'd and diversified, by the various combinations which may be made of them, not onely by casualties, but by the action of Subterranean Fires, and *estuaries*, and *menstruums*, such as I have elsewhere shewn to be lodg'd beneath the turf or *superficies* of the Earth. And the ascending Corpuscles of those Mineral Bodies, being most of them solid and subtile, may produce in the Bloud;

and so in the Body, far more odd, and violent Symtomes, than the peccant Humours that use to beget ordinary Diseases. Which may be one reason, and perhaps the chief, why the ancient Heathens, and *Hippocrates* himself, acknowledg'd in Pestilential Diseases *Σελον τι*, somewhat of Divine, surpassing ordinary Nature.

What these Mineral Substances are, whose steams produce such odd and dismal Symtomes, I think exceeding hard to determine. Yet, if I were to name *one* sort, I should perhaps think the least unlikely to be Orpiment. For, of the Poysonous Minerals we are acquainted with, I know not any of which there is greater quantity in the Bowels of the Earth; especially taking that name, in the latitude allowed it, by those skilfull men, that make three sorts of it, *viz.* Yellow, Red and White Orpiment, divers of whose mischievous Effects seem to agree well enough with the Symtomes of some Plagues,
and

and may be guessed to have at least a considerable interest in the production of them. But yet, to speak candidly, I do not think that these Minerals are the causes, even of all those Pestilences whose efficient may come from under the Ground: For several reasons, and some drawn from Experience, make me think that the Subterranean Regions have many kinds of very mischievous fossiles, of which Physicians, and even Chymists, have no knowledge, and for which they have not any distinct names; and that the various associations of these, which Nature may by Fire and *menstruums* make under Ground, and perhaps in the Air it self; may very much increase the number, and variety of hurtfull Matters, and also heighten their hostility to Humane Bodies: as I think may be argued from the factitious White Arsenick that is commonly sold in Shops, which though usually made of Orpiment, by the addition of so innocent a Body as

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common Salt, (which is found in great plenty under Ground,) is observ'd to be far more poysonous than Orpiment it self. And I remember that a skilfull Chymist, having in my presence tasted some prepar'd, and, as was thought, somewhat corrected Arcenick ; was quickly invaded by such Symtomes, as he thought would presently kill him. But, through God's blessing, I quickly put him out of danger, though not out of pain, by early prescribing him store of Oil of sweet Almonds, and something made of Lemmons, that I chanc'd to have by me : But to return to what I was saying ; Sandarach seems to be, but Orpiment whose yellow Colour is deepn'd to Redness: and native Arsenick, (for I have seen such a thing, though it rarely comes into *England*,) seems to be little other than pale or white Orpiment. And indeed in *Hungary*, all three may be found not far from one another in the same Mine ; As I learn'd by Inquiry from an observing

ving Eye-witness, by whose means,
 and of another Chymist, divers Na-
 tive Orpimental Minerals (to say
 nothing of Realgar) because it is a
 Factitious combination of Orpiment
 and Sulphur, came to my hands.
 And as this sort of Fossiles comprizes
 more numerous and various ones,
 than is vulgarly noted, so the very
 noxious effects of the *Effluvia* of
 Orpiment, are not unknown to di-
 vers Physicians: and the Learned
Sennertus gives a particular
 instance of it in a Painter, Senn. M.
 P. E. vi.
 p. 66.
 who upon opening a Box
 where Orpiment, which men of his
 Profession use as a Pigment, had been
 long kept, had his face all swell'd,
 and was cast into fainting Fits. And
 as White Arsenick is of a more
 piercing and corrosive nature, so it
 were not difficult to shew out of
 the Writings of eminent Physicians
 that *its effects* have divers times pro-
 ved very hurtfull, and sometimes
 mortal. When but externally worn
 in Amulets, especially if the Pores
 of

of the Skin were open by exercise and sweat; and the nature of the Symptomes produced seems to confirm our Hypothesis, since the Persons that wore these Arsenical Amulets were affected, some with great anxieties about the Heart, some with inflammation, some with burning Fevers, some with exulceration of the Breasts, so some with Pusles like those of the Plague, and these were sometimes black, as if made with a Caustick: most Patients were affected with great weakness and faintness, &c. as if they had swallowed Poison; and of one young Man 'tis recorded, that having heated himself in a Tennis-court with an Amulet upon his Breast, the virulence of its Corpuscles made him fall down stark dead upon the Spot. And 'tis a considerable Circumstance in these Observations, that several Patients were cur'd of the Symptomes that seem'd to be Pestilential ones by the same Remedies that are Alexipharmacal
against

against the Plague, whence it may also be made probable, that the Plague it self many times is a natural, though a dreadfull and anomalous Disease, since its Effects and Symptomes so much resemble those of acknowledg'd Poisons, and have been cur'd by Antidotes effectual against other Poisons.

I have not time to mention what I have my self try'd and observ'd about the bad effects of Orpiment, and its kinds. But I remember, that enquiring of an ingenious Man, who sometimes visited a Mine which was known to abound with Orpimental Fossils; he answer'd me, that when he walked over the neighbouring Grounds, he found himself much disorder'd, especially in his *Thorax* by the *Effluvia*, and that the Mine-men and Diggers were subject to a malignant anomalous and dangerous sort of Fevers, though he said he was apt to impute, I know not how truly, some part of their obnoxiousness to

to it, to their drinking too much strong Wine. But though 'tis probable the *Effluvia* of Orpimental Bodies may have a great interest in several Plagues, yet, I strongly suspect that many others may proceed from the steams of such Subterraneal Bodies as are not yet distinctly known to us; and possibly have their *Effluvia* variously combin'd, either beneath or *above* the surface of the Earth. I say *above*; because I have several times, and that without heat, combin'd separately invisible fumes of differing kinds, into manifestly visible ones in the free and open Air.

And that the Subterraneal *Effluvia* may produce effects, and therefore probably be of natures, very uncommon, irregular, and if I may so speak, extravagant, may appear in those prodigious Crosses that were seen in our time, *viz.* in the Year 1660. in the Kingdom of *Naples*, after an eruption of the fiery Mountain *Vesuvius*: of which Prodigious

digies the Learned *Kircherus* has given an account in a particular *Diatriba*. For these Crosses were seen on Linen Garments, as Shirt-sleeves, Womens Aprons, that had lain open to the Air, and upon the expos'd parts of Sheets; which is the less to be admired, because as *Kircher* fairly guesses, the mineral vapours were by the texture that belongs to Linen [which consists of threads crossing one another for the most part at or near right Angles] easily determin'd to run along in almost streight lines, crossing each other, and consequently to frame Spots resembling some one, and some another kind of Crosses. These were extremely *numerous* in several Parts of the Kingdom of *Naples*: in-somuch that the Jesuit that sent the Relation to *Kircher* says that he himself found thirty in one Altar-cloth, that fifteen were found upon the Smock-sleeve of a Woman, and that he reckoned eight in a Boy's Band: also their colour and magnitude were

were very unequal, and their *figures* discrepant, as may appear in many Pictures of them drawn by the Relatour : they would not wash out with simple water, but requir'd Soap ; their *duration* was also unequal, some lasting ten or fifteen days, and others longer before they disappear'd. And these Crosses were found not onely upon Linen Garments expos'd to the Air, but upon some of those (belonging to Altars) that were kept lock'd up in Chests (to which possibly they might have access by the Key-holes, or some unheeded chink.) To which strange *Phænomena* if I had the leisure to add some others that I have met with in *Agricola*, and other approved Authours, whose Relations my memory doth not now serve me particularly to cite ; I presume it would appear yet more probable that Subterranean *Effluvia* may now and then be of a very Anomalous nature, and produce strange effects, and among them
variety

variety of Pestiferous ones in the Air.

But, to add this upon the bye: though I fear Physicians will not be able to discover *all* the subterranean Bodies whose *Effluvia* produce or contribute to the Plague: yet I do not think it impossible that by diligent observations and trials, sagacious Men may discover *divers* of them; and perhaps Antidotes against them.

And though the business of this Paper be to treat of the Causes, not the Remedies of the Plague: yet I love Mankind too well, to suppress on this occasion an Observation, that, by God's blessing, may in some cases, save the lives of many. In the late great Plague that swept away so many thousands at *London*, there staid in the City an Ingenious Physician, that was bred by the Learned *Diemerbroeck*, (whose Book *De Peste*, I prefer to any I have yet read of that Disease.) This Doctor (whose name I am

sorry I have forgotten) hearing that I was desirous to receive an account of the Plague from some intelligent Eye-witness, and having soon after some occasion to pass near the Place in the Countrey where I then resided, was pleas'd to give me a visit, and a rational account of the main things I desired to know ; and when I inquired about his method of Cure, after he had told me that he had twice had the Plague himself, whereof he shewed me some effects ; he added, that after many and various trials, he perceiv'd that abundance of his Patients died, after the Bubos, (Carbuncles) or Pestilential Tumours appear'd ; because upon a little refrigeration of the Body by the Air, and oftentimes by the very fear that disheartened the Patient, the Tumours would suddenly subside, and the Pestilential Matter recoiling upon the Vital Parts, would quickly dispatch the fatal work. Wherefore he bethought himself of

a me-

a method, by means of which he assur'd me, he had not lost one Patient of very many he treated ; if he could but, as he usually did, by good *Alexipharmical*, and Cordial Remedies, enable and excite Nature to expell the peccant Matter into a Tumour ; for then he presently clapp'd on an appropriated drawing Plaster, which would never suffer the Tumour to subside ; but break it, or make it fit for opening, and thereby give Nature a convenient vent, at which to discharge the matter that oppress'd her. This Plaster 'twill easily be thought I was desirous to know ; and he told me 'twas a Chymical one, and that 'twas no other than the *Magnes Arsenicalis* of *Angelus sala*, whose description, because the Book where in 'tis found, is in few hands, I have here annext. If this prove as successfull in other Plagues, as it did to those that us'd it in that of *London* ; there will be just cause to admire and praise the benignity of Divine

Providence, which in a poisonous Mineral, that probably does oftentimes concur to produce the Plague, has laid up a remedy for it.

Emplastrum attractivum Pestilientiale nostrum.

℞ Gummi Sagapeni, Ammoniaci, Galbani an. ℥iii. Terebinthinae coctæ, cereæ virginis ana ℥iv℥. Magnetis Arsenicalis subtiliter pulverisati ℥ii. radic' Aronis pulverisat' ℥i. Gummi depurentur cum aceto scyllitico, & ad consistentiam Emplastri coquantur, & postea ponderentur, deinde cum rebus aliis fiat Emplastrum lege artis, hoc Emplastro Carbunculus obducatur, quod paucis horis venenum extrahit.

Præparatio Magnetis Arsenicalis antea dicti.

℞ Arsenici ChrySTALLINI, sulphuris vitri, antimonii crudi ana, hæc tria in mortario ferreo pulverisentur, in vase fortis-

*fortissimo vitreo, ponantur ad ignem
arenæ donec vitrum optimè incalescat,
& prædicta solvantur & liquentur
instar picis, quod observabitur quan-
do filum quoddam immittitur in fun-
dum quod extractum postea instar Te-
rebinthinæ trahetur ubi satis coctum
erit, postea remove vitrum ab igne, &
ubi refrigeratum est rumpe, & subti-
liter pulverisa, & ad usum serva.*

By the same motive (*Philanthro-
py*) I am induc'd to add on this oc-
casion, that having had some op-
portunity to oblige an ancient and
very experienc'd Physician, to
whose care was committed a great
Pesthouse, where the Contagion
was so strong, that he lost three
Physicians that were to be Assi-
stants to him, and three Chirur-
geons of four that were to be sub-
servient to him; I desir'd to learn
of him, if he counted it not too
great a secret, what Antidote he
us'd to preserve himself from so vio-
lent and fatal an Infection. This re-

quest he readily granted, but with-
all told me, that his method would
not seem to me worth mentioning,
if I were one that valu'd Medicines
by their Pompousness, not their U-
tility. For, besides ardent Prayers
to God, and a very regular Diet,
his constant Antidote was onely, to
take every Morning fasting a little
Sea-salt dissolv'd in a few Spoonfulls
of fair Water ; which he made
choice of, both because it kept his
Body soluble without purging or
weakening it, and for other Reasons
which I must not now stay to set
down. I know this Medicine may
appear a despicable one ; but yet in
my Opinion it ought not to be de-
spis'd, after such Experience as I
have related has recommended it.
For I think it desirable, that notice
be taken of all Remedies, that have
been found by good Trials, not
bare Conjectures or uncertain Re-
ports, available against the Plague.
For, since Pestilences, as we have
lately noted, are exceeding various

in

in their kinds, 'tis very possible, and not unlikely, that their Appropriated Remedies may be so too. And therefore I would not easily lay aside every Medicine, that this or that Learned Physician may speak slightly of, or even may declare that he has found it unsuccessful against the Plague; since the same Medicine may be available in a Pestilence of another kind, in which perhaps the Remedies commended by the Physician we speak of, will be found inefficacious.

This Consideration forbids me to pass by what happen'd to me in the great *London* Plague above-mention'd; namely, that a very Learned Physician having once recommended to me an Herb little noted in *England*, as a most effectual and experienced Antidote against the Plague, I caus'd it to be cultivated in a Garden (as I still do every year;) and when the Pestilence rag'd most, having some of it by me, made up with a little Sugar in the

form of a fine green Conserve, I sent it to two infected Persons, who, by the Divine Benediction on it, both of them recover'd. But having made but those two Trials, I dare not ground much upon them onely; though I usually keep the Plant growing in a Garden, partly because both the Taste and Colour; one or other of which in most Antidotes is offensive, are in this pleasant; and partly because some little Experience has invited me to believe the Commendations that I have found given of it, against the Bitings of venomous Creatures: whereof I remember a notable Instance is recorded by *Petrus Spehrerius* of a Roman, who having with his Staff pierc'd or crush'd a Viper, that he took to be dead, had so strong a Venom transmitted along the Staff, that the ensuing Night he had a very great Inflammation in both his Lips, to which

*In Observat. nobil. apud Schenkium, l. 7.
Observ. Med.
Tit. de venenis
ex animalibus.*

which superven'd an exceeding Ardent Fever and strange Tortures; from all which *Serianus Pacyonius*, a noted Physician that was call'd to him, free'd him as it were by Miracle, by the Juice of *Goats-rue*, or as others call it *Galega*, that grew copiously in that Place. It may without disgust be taken somewhat plentifully, (and so it ought to be) in its entire substance as a Salad; or else one may give its Conserve, its Syrup, or, which is better, its Juice newly express'd.

(3.) It likewise agrees with our *Hypothesis*; that sometimes the Plague ceases, or at least very notably abates of its Infectiousness and Malignity, in far less time than according to the wonted course of that ravenous Disease, Physicians did, or rationally could expect. For sometimes it may happen, that, though the Temperature or Intemperateness of the Air continues the same, the matter that afforded the Pestiferous Exhalations may be either

ther spent under ground, or so alter'd by combination with other subterranean Bodies, or by some of those many Accidents that may happen, altogether unknown to us, in those deep and dark Recesses. And if once the Fountain of these noxious *Effluvia* be stopt, so that those that are in the Air cease to be recruited, the Wind and other causes may in a short time dissipate them, or at least dilute them with innocent Air, so far, as to keep the Disease they produc'd from being any thing near so mischievous as before. And here I consider, that it may several times happen, that, though the Minerals that emit the hurtfull Expirations, remain where they were under ground, and be not considerably wasted, yet their fatal Effects may not be lasting, because the *Effluvia* were generated by the conflict of two or more of them, which vehemently agitated one another, and sent up fumes, which ceas'd to ascend, at least in great plenty, when
the

the Conflict and Agitation ceas'd.
 As, I have try'd that by putting
 good Spirit of Salt upon Filings of
 Steel or Iron in a conveniently
 shap'd Glas, there will be made a
 great conflict between them, and
 without the help of external Heat,
 there will be sent up into the Air
 store of visible Fumes of a very Sul-
 phureous Odour, and easily inflam-
 mable, which copious elevation of
 Fumes will lessen or cease, as does
 the tumultuous agitation that pro-
 duc'd them. And so likewise, if
 you pour *Aqua fortis* upon a conve-
 nient proportion of Salt of Tartar,
 there will be at first a great ebulli-
 tion produc'd, and, whilst that con-
 tinues, store of red and noisome
 Fumes will be elevated, but will
 not long outlast the commotion of
 the mixture, whose active parts will
 in no long time combine into a kind
 of nitrous Salt, wherein the noxious
 parts of the *Menstruum* are as it were
 pinion'd, and hinder'd from evapo-
 rating or ascending, though really
 they

they retain much of their pristine nature, as I elsewhere shew.

It may also happen, that soon after that commotion of subterranean Matter, which sent forth pestiferous Exhalations, a more intense degree of subterranean Heat, or perhaps the same latent Fire, extending it self farther and farther, may force up Fumes of another sort, that being of a contrary nature, may be, if I may so speak, antidotal against the former; and by precipitating them, or combining with them, may disable them from acting so mischievously as otherwise they would. To countenance which I shall tell you, that I have sometimes purposely made Distillations, in which one part of the Matter being, after the operation ended, put to the other, there will ensue a sudden and manifest conflict between them, and sometimes an intense degree of Heat. And that mineral Exhalations, though otherwise not wholesome, may disable pestiferous Efflu-

* via,

via, may be gather'd from what I lately noted about a Countrey, which abounding with veins of Cinnabar, was, probably by their exspirations, preserved from the Pestilence. And our *Hypothesis* will perhaps appear somewhat the more probable, if we reflect on what I lately mention'd of the sudden check, that is almost every Summer given to the Plague, which at that time is wont to reign at *Grand Cairo*. For since 'tis generally observ'd and complain'd of, that *Morbisick* Causes doe their work much more effectually than *Sanative* ones. It seems very probable that Exhalations ascending from under-ground into the Atmosphere, may be capable of producing pestilential Fevers, and the Plague it self, since those Corpuscles that impregnate the *Egyptian* Air upon the swelling of the Nile, are able to put a speedy stop, not only to the contagiousness, but to the malignity of the Plague, even when 'tis assisted by the Summer Heat,

Heat, which at *Grand Cairo* is wont to be excessive.

But having insisted perhaps too long on this *Egyptian* Pestilence, I shall onely add, by way of Illustration of the Conjecture that invited me to mention it, that the accession even of Expirations that are not themselves wholesome, may sometimes serve to correct the Air, and put a sudden check to an Epidemical Disease. For Corpuscles of differing kinds may by their Coalitions acquire new Qualities, and each sort of them lose some of those they had before : as, suppose there wander'd in the Air a great many *Effluvia*, which by their determinate shape and bulk were apt to corrode or irritate the Lungs, or the Membranes of the Brain, &c. as those of Nitre are to corrode Silver ; it may happen that another sort of Reeks, though in their own nature unwholesome, may, by associating themselves with the first sort, and composing with them Corpuscles of
new

new qualities, abolish or much weaken the noxious ones they had before, in reference to this or that part of the Humane Body. Though the Spirits of Salt-peter will readily corrode Silver, yet if you add to them (as for some purposes I am wont to do) about half as much or less of the spirituous Particles of common Salt, (which yet are corrosive enough, and will fret asunder the parts of Iron, Copper, Antimony, &c.) there will emerge a Body that will not at all corrode pure Silver.

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PRO-

PROPOSITION IV.

'Tis very probable, that most of the Diseases that even Physicians call New ones, are caus'd either chiefly or concurrently by Subterranean Steams.

THE Product of my first Endeavours to bring credit to the foregoing Proposition, appearing to have miscarry'd, when I came to send to the Press the things I had written about it; that at least what can be preserv'd of it may not be lost, I shall substitute in stead of it the following Account.

At the entrance of my Discourse I observ'd that the Term *new Disease* was much abused by the Vulgar, who are wont to give that Title to almost every Fever, that, in Autumn especially, varies a little in its Symptoms, or other Circumstances, from the Fevers of the foregoing Year

Year or Season. And therefore I declared, that by *new Diseases* I meant onely such, whose Symptoms were so uncommon, that Physicians themselves judg'd them to deserve that appellation; Such, for instance, as the *Sudor Anglicus* or Sweating Sickness; that Disease which the learned *Wierus* and others call in Dutch *Die Varen*; an unheard-of Disease describ'd by *Ronseius*, that in the Year 1581 invaded and destroy'd many in the Dukedom of *Lunenburg*; to which many Physicians add the Rickets, and others generally the *Lues Venerea*. Having clear'd the Terms, I next consider'd whether there were really any *new Diseases* properly so call'd, and gave some reasons to suspect that some Diseases, which among Physicians themselves have pass'd for *New*, were extant before *in rerum natura*, though not in the Countrey wherein even the learned judg'd them to be new. And I intimated, that to examine this Suspicion thoroughly, 'tis not safe

to acquiesce in the Books of Physicians onely; but 'tis fit to consult the Writings of Geographers, whether *ancient* (among whom I particularly recommended *Strabo*) or *Modern*, together with the Relations of Historians, Navigators and other Travellers. And here I inquired, without determining any thing, whether the *Lues Venerea* be, as most Physicians are wont to suppose a Disease wholly new, or onely new to our European World, and brought hither from some African or other remote Region, where it may be probably suspected to have long been Endemical.

But taking it for granted, with the generality of Physicians, that some new Diseases are to be admitted; I advanced to consider some of the Causes, to which they may be imputed; And to give some reasons, why I do't acquiesce in their Opinion, though very general, that derive them onely or chiefly from the varying influences of the Heavenly Bodies.

Bodies. For the most powerfull of those, namely the Sun and Moon, act in too general and indeterminate a way, to afford a sufficient account of this affair. And as for the other Lights, the fixt Stars, besides their being universal and indefinite agents, their scarce measurable remoteness makes it justly questionable, whether they have any sensible Operation upon any part of our Bodies, save our Eyes. And, *though* I deny not that great intemperateness of the Air, as to the four first Qualities, as Heat, Cold, Driness and Moisture, are wont (not over justly) to be call'd, may dispose mens Bodies to several great Distempers, and may also be concurrent causes of those we are speaking of: *yet* neither can I acquiesce in these, when I consider how much more frequently they happen, than new Diseases do; and that their action, though various, is too general and indeterminate to perswade me, that they can be the adequate causes of effects so rare and

anomalous, as Diseases odd enough to deserve the Title of new.

But now; the Subterranean Region of our Globe, besides that it is always near us, abounds with variety of noxious Minerals, and probably conceals great quantities of differing sorts of them, that are yet unknown to us. And

*A Discourse
of Subterranean
Streams as they
affect the Air.*

since we have elsewhere proved, that there want not causes in the Bowels of the Earth, to make great and irregular, and Sometimes sudden Confluxes, Conflicts, Dissipations, and other considerable Changes, amongst the Materials, that nature has plentifully treasured up in those her secret Magazins. And since, in making out the three former Propositions, we have manifested, that the Subterranean parts of the Globe we inhabit, may plentifully send up Noxious *Effluvia* of several kinds into the Air; it ought not to seem improbable that among this Emergent variety of Exotick and hurtfull
Streams,

Steams, some may be found capable
 to disaffect Humane Bodies, after
 a very uncommon way, and thereby
 to produce *new Diseases*; whose du-
 ration may be greater or smaller, ac-
 cording to the lastingness of those
 Subterranean causes, that produce
 them. On which account it need
 be no wonder, that some new Dis-
 eases have but a short duration, and
 vanish not long after, there appear-
 ing the Source or *Fomes* of the Mor-
 bifick *Effluvia*, being soon destroy'd,
 or spent: whereas some others may
 continue longer upon the Stage, as
 having under ground more settled
 and durable causes to maintain them.
 Which last part of the Observation
 may be illustrated by what happen'd
 in *Calabria*; which Province, though
 it have been observed to have acqui-
 red, within these two or three ages,
 the faculty of produ-
 cing *Manna* upon cer-
 tain Trees*; yet this
 great change, though
 sudden enough, had

* C. Magnenus de
Manna, cap. 9. Dic
amabo, Alcomari, cur
 ante trecentos annos
 nullum *Manna* fuit
 in Oenotria; jam cer-

*re aderant Pagi ibi-
dem urbisque vicina
neque sefellisset curio-
sam Incolarum soler-
tiam. & c. 15. ante
240. annos nullum
Manna Calabrensis
in Autoribus vestigi-
um est.*

it seems such stable
causes, as well as of
great extent, that it
hath lasted several
scores of years, and
continues in that
Countrey to this day.

I am not ignorant that the whole
Doctrine propounded in the four
Propositions about the Insalubrity of
the Air, is not at all comfortable ei-
ther to Patients or Physicians: But
important Theories deserv'd to be
inquir'd into, and, if true, to be de-
liver'd though we could wish they
were untrue. And judicious men
rather thank than blame those that
have given us account of latent or
unsuspected, though perhaps irreme-
diable causes of Diseases and of death;
or have recorded the Histories of
some Poysons, whereof the true An-
tidotes are yet unknown. Uncom-
mon Notions about Diseases may
serve to enlarge the Physicians mind
and excite his attention and curiosi-
ty: and, besides that they may keep
him

him from too obstinately persisting in the use of receiv'd Medicins, though unsuccessful, upon a Supposition that the Disease can have no other causes, than those wont to be assign'd it by Classick Authours: besides this, I say; I do not despair, but that either the sagacity or fortune of this inquisitive age, or at least of Posterity, may by the blessing of God be happy enough to find proper Remedies, even for those Diseases that proceed from Subterranean *Effluvia*, when once by proper Signs they shall be distinctly discover'd; (Of which power of appropriated Remedies) I have known some Instances, as to the very bad Symptoms produc'd by Antimonial and some other Mineral Fumes.

Some of the Points discours'd of under the fourth Proposition, were of affinity enough to Paradoxes to have need of being illustrated or confirmed by Observations and Experiments. And therefore having accidentally retriev'd some of this
last

last nam'd sort, I shall venture to subjoin them as a *Specimen*, though without Transitions or Applications, but just as I found them thrown together, in one loose sheet, wherein I lighted on them. But it is time to conclude with the recital of the promised Experiments. Which I would immediately do, but that I hold it fit to premise, by way of Introduction to them, that I hope the Things hitherto discours'd will appear much the more probable, if we shall prove by Experiments, that which seems much less likely than any thing we have above deliver'd; namely, that Metals completely formed and malleable may be elevated into the Air, and that perhaps without any great violence of Fire, in the form of Exhalations and Vapours; the singly invisible Corpuscles still retaining their Metalline nature. This at least, as to some Metals, I have endeavour'd to prove in another Tract, [entitl'd a *Paradox about the Fuel of Flames.*] But because that

Dis-

Discourse was never publish'd I will here set down two or three Experiments, (not mention'd, that I remember in it.) Which I do, the more willingly, because it may be a Thing of no small moment in Physick, if it be shewn that Fixt and solid Bodies, such as Metals are, may by art be reduc'd into such minute Corpuscles, that without loosing their nature and all their Properties, they may become parts of Fumes, or perhaps of invisible Vapours, or even of Flame it self.

*Particulars belonging to the
IVth Proposition.*

EXPER. I.

WE took three Parts or Pounds of *Dantsic Vitriol* (which is blew and somewhat partakes of *Copper*) and two Parts or Pounds of good *Sea-salt*; these being very well
pow-

powder'd and mix'd were distill'd with a strong naked Fire, to force out all that could be driven over: and by this means we not onely obtain'd a Spirit of Salt of a manifestly blewish Colour, but there ascended also a considerable quantity of *Powder*, which being shaken with the *Liquor*, settled at the bottom of it in the form of a Powder, which was judg'd to consist of *Corpuscles* of a *Cupreous* nature, and perhaps also of some of a *Martial* nature. But I unhappily neglected the opportunity of examining this Powder, which came up in quantity enough to have serv'd for various Trials.

EXPER. II.

By substituting *English Vitriol* (which is green, and is much more abundant in *Iron* than that of *Dantisc,*) and proceeding in other respects as in the former Process, we obtain'd a very yellow Spirit, with
a con-

a considerable quantity of a yellowish Powder, that was guess'd to be a kind of *Crocus Martis*.

EXPER. III.

We took very thin Plates of *Copper*, and cast them into a Retort, upon an equal or a double weight (for we did not always use the same) of good *Mercury Sublimate*; and luting on the Receiver, gave a Fire by degrees for several hours: by which means we usually obtain'd some running Mercury, (which seem'd to be very well purifi'd and was perhaps also impregnated) together with some Sublimate that had not fasten'd upon the Copper. And at the bottom of the Retort we had good store of a ponderous and brittle substance, that did not look at all like a Metal, but rather like something of a Gummous or Resinous nature, being also fusible and inflammable almost like sealing Wax. This, having not opportunity to
pro-

prosecute the Experiment at home, I put into the hands of an industrious Physician, that was earnest with me to impart to him the Process, and let Him pursue it for me. He according to my direction expos'd this *Metalline Rosin* (if I may so call it) grossly beaten to the free Air, where it did, according to Expectation, in a short time change Colour, and turn to a kind of *Verdegreece*: which being dissolv'd in good Spirit of Salt gave a Solution of a very lovely green Colour. This being slowly distill'd *ad Siccitatem*, yielded but a very weak and phlegmatick Liquour; and the *Caput Mortuum* was again dissolv'd in fresh Spirit, and the *Menstruum* abstracted as before. This was done several times, till the matter was so impregnated, that the *Menstruum* being drawn off from it, came over as strong almost as when it was put on. This done, the thus impregnated *Verdegreece* was diligently mingl'd with *Tripoly*, or some such insipid and fixt additament, and

and distill'd with a strong Fire; by which means it afforded good store of a Liquour Colourless like common Water: which made the Physician suppose the Experiment had miscarry'd, till I having dropt into it a Colourless Liquor, namely Spirit of Hartshorn or of Sal-armoniac; He was much and delightfully surpriz'd, to find it presently disclose a deep and lovely blew Colour. What afterwards became of this odd Spirit, I need not here declare; what has been said being sufficient, to shew that Corpuscles of Copper may be elevated in the form of Exhalations both transparent and Colourless. The next following Experiment though in part mention'd by some Chymist is here subjoin'd, because it's necessary and applied to a particular purpose.

EXPER.

EXPER. IV.

If from good *Cornish Tin* you warily distill an equal or double weight of Venetian *Sublimate*, into a very large Receiver very well luted on to the Retort, you will obtain a spirituous Liquor, which as soon as the free Air comes to touch it, will send up abundance of white Exhalations in the form of a thick Smoak, which will continue to be emitted much longer than one would imagine. But that which I desire to have particularly observ'd in this Experiment is, that though this Liquor be thus apt to emit Smoak, not onely plentifully, but as one would think with Violence, yet I found by Trial, that even when I put it into a Vessel not strait mouth'd, if I did but lay a piece of a single leaf of Paper flatwise upon the Orifice of the Glass, so as to cover it all, the visible production of the Fumes would presently cease; and the Liquor would lie
like

like common Water, as long as the Paper lay, though but lightly upon the Glass; though upon the Removal of that, the Liquor would send up plentiful Fumes as before, which seems to argue, that some Metalline Substances may, by the contact of the *Air*, have their Copious ascension into the Atmosphere very much help'd and promoted, as if the *Air* had Saline or other sort of Particles in it, that are in reference to some Mineral Bodies of a very volatilizing nature. The way by which I have divers times elevated the Fixedst of Metals, *Gold* it self, I have deliver'd in another Paper, and shall not here repeat it. But I shall now set down an Experiment that when it is carefully made, is easie to be perform'd, and yet affords a notable and sensible Proof, that the Corpuscles of a Metal may be made to ascend, and that plentifully, even with a very moderate Heat, under the form of ordinary Fumes or Smoak.

I

To

To effect this I devis'd the following Experiment.

We took *Copper* and dissolv'd it in good *Aqua fortis*, till the *Menstruum* was Satiated with it, in the strong Solution we steep'd a while some brown or other porous Paper, that being fitter than the finer, to soak up the *Menstruum*; then slowly evaporating the superfluous moisture, we put a quantity of this imperfectly dry'd Paper upon the Hearth, at such a distance from a Fire of actually flaming Wood that the Paper was not kindled, but yet was so scorch'd, as to afford very plentiful Fumes: these look'd like ordinary Smoak, whilst they mov'd through the Air, and would questionless have mingl'd with it, and been dispers'd through it, if the Body that emitted them had not been purposely plac'd for a future design. But when the motion of the Air towards the Flame had carry'd these Fumes

to

to it, the Metalline Smoak did,
 as I expected, disclose its nature;
 for being actually kindled, it
 ting'd the Flame of a lovely Co-
 lour, for the most part Blew,
 and sometimes Green, as it hap-
 pen'd to be variously mix'd with
 the Flame and Smoak of the Wood,

T H E E N D.

to the melting snow
as I expected, though in nature
the being actually kindled, in
the flame of a lovely Co
lour, for the most part
and sometimes clear, as it hap
pens to be smoothly mixed with
the flame and smoke of the Wood

THE END

A
Short Supplement
TO THE
ESSAY
OF THE
GREAT EFFECTS

OF
Even Languid and Unheeded

LOCAL MOTION.

THAT I may not be altogether wanting to the Expectation that may have been rais'd, by a Passage in the Advertisement prefix'd to the foregoing Essay; I shall here subjoin some Particulars, which perhaps will not be unwelcome to the Readers, that occur'd to my remembrance, whilst I was,

K

with

with a tranſient Eye, reviewing the Heads of the paſt Diſcourſe. But theſe *Paralipomena* or Supplements will be but few, not onely becauſe of my want of leaſure to review the Tract they belong to deliberately, but alſo becauſe ſome Inſtances, that might be here ſubjoin'd, may be more opportunely brought in in other Papers.

GREAT EFFECTS

To the III^d. Chapter.

THAT the Motion of the Air that accompanies Sounds may be propagated to great Diſtances, and yet make conſiderable Impreſſions on the Bodies it finds there, diſpos'd to admit its Action, may be notably confirm'd, by a *Phænomenon* I have met with, in the learn'd Mathematician *Borellus*, who relates it upon his own knowledge, and not unſervedly magnifies it: which I ſhall therefore recite in his own

own Words. "Aderam Borel. de vi

"(says he) *Tauromenii* Percussionis.

"*Siciliæ*, quando *Ætna* Prop. CXI.

"mons eruptionem quandam effecerat

"propè *Eunam*, urbem fere 30. Mil-

"*liaria* à *Tauromenio* distantem, tunc

"vicibus interpolatis eruptiones in-

"gentes ignis vorago efficiebat, grandi

"sono & strepitu, & tunc omnia *Tau-*

"*romenii* ædificia, tremore concutie-

"bantur, in quo Circumstantiam no-

"tatu dignissimam observavi: scili-

"cet, quod domus & ædificia quæ di-

"rectè exposita erant prospectui ejus-

"dem voraginis, vehementissimè con-

"cutiebantur; reliquæ verò domus,

"quæ conspectu voraginis privaban-

"tur, satis lentè & leniter tremorem

"efficiebant. Upon which matter of

fact he thus argues: "Profectò, si

"huiusmodi tremor factus fuisset à

"concussione & reslitione soli *Tauro-*

"*menitani*, omnes domus æquè con-

"cussæ fuissent, & æquali tremore

"agitatae, ita ut non possit conspectus

"voraginis tam insignem & eviden-

"tem inæqualitatem tremoris pro-

" creare: igitur necessario à tremore
 " ejusdem aëris incussō in parietibus
 " domorum liberè percussiones excipi-
 " entum, agitatio illa efficiebatur. Vi-
 " deas hinc, (infern he) quanta soni
 " ad 30 miliarium distantiam effi-
 " cacia sit.

To the Vth. Chapter.

THAT Motion may be propa-
 gated far, through Bodies of
 differing Natures, may be inferr'd
 from what is mention'd in this Chap-
 ter, especially about Earthquakes.
 But because it may reasonably be
 suspected, that the Active Matter
 which produces those stupendious
 Motions, is dispers'd into divers
 Places, and may be of considerable
 Extent, I shall here subjoin, out of
 the Eloquent *Famianus Strada*, an
 Instance, which is much the most
 memorable to my purpose that I re-
 member to have met with in His-
 tory;

tory; to manifest to how great an extent a Motion excited in a very narrow compass, perhaps but a very few fathom square, may be propagated through differing *Mediums*, and one of them as solid as Earth. This famous Historian then, having describ'd a stupendious Work, that had been with great skill and care made by the *Prince of Parma*, to keep the City of *Antwerp*, which he closely besieged, from being reliev'd by the River *Scheldt* (which, though not broad, is deep) proceeds to relate, that an *Engineer*, who was a great Master in his Art, having undertaken to destroy this great Work with a Vessel (which I think we may call a *Floating Mine*) fraught with Gunpowder, Fireworks, &c. perform'd it with so tragical a success, that some Spanish Officers that were present, reckon'd 800. to have been kill'd outright, besides a great number that were wounded and maim'd. But that Part of the Narrative which comes home to our pre-

sent purpose, is deliver'd in these Words.

Famian. Strad.
de Bello Belg.
Dec. 2. lib. 6,
vel 7.

On a sudden the fatal Ship burst, with such a horrid crash, as if the very Sky had rent asunder, Heaven and Earth had charg'd one another, and the whole Machine of the Earth it self had quaked. For the Storm of Stones, Chains and Bullets being cast out with Thunder and Lightning, there followed such a Slaughter, as no man, but that actually it happen'd, could have imagin'd. The Castle on which the Infernal Ship fell, the Pile-work of the Bridge to St. Mary's Fort, that part of the Naval Bridge next the Castle, Souldiers, Mariners, Commanders, a great number of Cannons, Armour and Arms; all these this furious Whirlwind swept away together, tossed in the Air, and dispers'd as Wind doth Leaves of Trees. The *Scheldt* prodigiously gaping was first seen to discover its bottom, then swelling above the Banks, was even with

with the Rampiers, and overflowed St. Mary's Fort above a foot. The motion of the panting Earth N. B. extended its force and fear above nine Miles. [If he means the Miles of that Countrey, or Dutch Leagues, they amount to 36 English Miles.] There were found Stones, and that very great ones, as Grave-stones, and the like, a Mile off the River, struck into the Ground, in some places four Palms.

To the VIth. Chapter.

Observation I.

WHAT is delivered in this Chapter about the Operation of Sounds and Animals, particularly that which is mention'd (Pag. 72.) about the Effect of Musick upon Serpents at *Grand Cairo*, may be not onely confirm'd but exceeded, by a strange Relation that I had from a Person of unsuspected Credit.

Which Narrative having appear'd to me so considerable, as well to deserve a place among my *Adversaria*, I shall subjoin that part of it which concerns our present Subject, in the words wherein I find it set down.

Sir J. C. a very candid and judicious Traveller, favouring me yesterday with a visit, told me among other remarkable things relating to the *East Indies*, (which Countries He had curiously visited) that He with divers European Merchants had seen, (and that if I mistake not, several times) an Indian, who by many was thought to be a Magician, that kept tame Serpents of a great bulk. And that when the Owner of them plaid upon a Musical Instrument, these Serpents would raise themselves upright into the Air, leaving upon the Ground but 3 or 4 Inches of their Tail, upon which they lean'd for their support. He added, that at the same time that they erected their Bodies, they also stretch
and

and lengthen'd them in a strange and frightfull manner; and whilst they were thus slender, they were taller than He or any man of ordinary stature. But that which appear'd to Him the most wonderfull and surprising, was, that they manifestly seem'd to be very much affected with the Musick they heard; insomuch that some Parts of the Tune would make them move to and fro with a surprising agility, and some other Parts of it would cast them into a Posture, wherein they seem'd to be half asleep, and as it were to melt away with pleasure.

To the VIth. Chapter. Pag. 75.

Observation II.

BEcause the Truth even of the principal effects of the Biting of the *Tarantula*, has of late been publickly call'd in question, I was glad to meet with an ingenious Traveller, that

that in *Calabria* or *Apulia* was Himself bitten by one of those venomous Insects; and though it were but slightly, yet the Effects He felt in His own Body, and those greater ones He saw produc'd in other Persons, that were more unhappily bitten, brought Credit to the main of what sober Writers affirm of the Symptoms and Cure of that Poyson. And the learned, &c.

To the VIIth. Chapter. Pag. 83.

MUCH of what is delivered in this Chapter and elsewhere, about the Operation of Air or invisible Fluids (whose Motions affect not the Touch) upon Congruous Solids, may be confirm'd by that notable Experiment, which has been published in an Elegant Discourse by the learned *Morhofius*; about a Dutch Wine Seller in *Amsterdam*, by name *Nicolaus Petterus*, who, having found the Tone or Note peculiarly belong-

belonging to a large belly'd drinking
 Glafs, Such as the Dutch call *Römer*,
 and many here call *Rhenish Wine*
Glasses, would, by accomodating
 his voice exactly to that Tone, and
 yet making it loud and lasting, make
 the Vessel, though not visibly touch-
 ed, first tremble and then burst;
 which it would not do, if the Voice
 were, though but a little, too low or
 too high. This notable Experiment
 has been seen by many *Vertuosi*, both
 before and since he publish'd it. And
 the very ingenious Writer, as he pas-
 sed through *London*, not onely rela-
 ted it to me, but very civilly offer'd
 me farther satisfaction, if I could fur-
 nish Him with a *Römer*, which I was
 very sorry that where we then were
 was not to be procur'd.

To

To the VIIIth. Chapter.

Observation I.

IT may add probability to some things deliver'd in this Chapter and in divers other Passages of this Treatise, if I here recount a strange *Phænomenon*, that came into my memory whilst I was running over those Parts of this Discourse.

The *Phænomenon*, in short, was this. Having met with divers pieces of transparent Glass, which I had reason to think to be of a Texture or Temper very differing from ordinary Glass, I thought fit to try, whether some of them were not far more springy and brittle than their thickness would make one expect. And accordingly, though I found several wherein the Experiment would not succeed, especially if their figure were not convenient, yet with some others, I had very good success, and par-

particularly with some that were shap'd almost like the sharper End of the neck of a Retort. For though these pieces of Glass were much thicker than such necks are wont to be, being perhaps 6 or 7 times as thick as common drinking Glasses, yet I more than once made the Tryal succeed so well, that, by obliquely scratching them, or tickling them if I may so speak, on the inside with the head or point of a Pin, they would forceably burst into many pieces in my hand. In which surprizing *Phænomenon*, the matter of the Glass seem'd to contribute something to this odd Effect, of so languid a motion, but much less than the Texture, or Tension, it obtain'd by the peculiar way of ordering it in the Fire and the Air. To

To the VIIIth. Chapter.

Observation II.

TO shew that the Suspicion I mention my self, a little before the end of this Chapter, to have had, that the breaking of the Stones there spoken of might possibly be produc'd or promoted by some impressions, remaining after the strokes employ'd to force the Stones out of their Beds, was not altogether without ground.

I shall here observe, that it need not seem incredible, that faint strokes and attritions may leave more lasting and operative Motions among the Insensible Parts, even of compact and solid Bodies, than one would readily imagine. For I have several times found, sometimes by Observations designedly made, and sometimes by undesigned Accidents, that, having caus'd somewhat thin Vessels of Glass, especially Urinals, to be diligently

ligerly made clean with Sand mixt with Water, to loosen or grate off the foulness that adher'd to the sides of the Vessel; though the Vessels, after having been thus made clean, did not appear to have receiv'd the least injury, and would continue very intire perhaps for several hours, yet after that time they would of themselves break with noise, and thereby become unserviceable for the future. But though this happen'd to many Urinals, yet, because to more others it did not, it seem'd probable that the dissillation depended chiefly upon the peculiar texture of the Glass in this or that Vessel, whether acquir'd by a mixture of the Ingredients, that was not uniform enough or made in a due proportion; or else by the too hasty refrigeration of the Vessel, especially if it chanc'd, as is not very unusual, to be cool'd more hastily in one part than another.

Diamonds and some Conferences I had concerning things belonging to his Religion, he To

To the IXth. Chapter. Pag. 110.

Observation: I have seen many things that have been polished by the use of the Mill.

BEcause there are divers Gems; particularly those Transparent ones that are Red or Blew, that are much harder than Iron or steel, it may much strengthen the Proof of our 8th Observation; if I here relate that a Jeweller to a great Princess answer'd me, that when he polish'd Saphyrs, Rubies, and some sorts of other hard Gems, upon his Mill, they would seem when attrition had made them very hot, to be all on Fire, like so many little Coals: And that each of them had the light it afforded ting'd with a Colour proper to the Stone; so that the Ruby gave a Red Light, the Saphyr a Blew, &c. And I remember that inquiring of a skilfull Cutter of Diamonds and Polisher of Gems, whose Customer I had been, about some Conjectures I had concerning things belonging to his Profession, he answer'd

answer'd me that sometimes, when he polish'd certain Stones, especially Rubies, that were pretty large and perhaps not thick, he could plainly perceive that the Stone gap'd at and near the Edge, as if it were begun to be crack'd; which sign admonish'd him to make haste to slacken the Motion of the Mill, lest the Stone should absolutely burst; which if it did not he could not perceive any Flaw in it when it was thoroughly cold, but, which was strange, it appear'd as entire as ever. He added, in confirmation of what he had said of the intense Heat that Gems would sometimes acquire by Attrition, whilst they were in polishing, that having lately given by this means too great a degree of Heat, to an Oriental Topaz (which sort of that Gem is very hard,) it crack'd upon the Mill, in so much that one part of it quite separated from the rest, and spoil'd the Stone in the capacity of a Gem; as a Proof whereof he had laid it aside for me, and would needs make me accept it, as

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a cu-

a curious, though not an usefull;
thing.

To the IXth Chapter.

Observation II.

TO confirm what has been said in the 8th Observation, to shew that slow and insensible Intestine Motions of the Parts of a Body that seem quiescent, may be very operative, chance afforded me a notable Instance, which was this. I had, to preserve a Liquor from which I expected a curious Experiment, inclos'd it in a strong Vial, to whose neck a thick Glasse Stopple was but too exquisitely adapted. This Vessel I set upon the Edge of a Window, in a high and secure place, that it might not be mov'd. There it continu'd many Months, or, if I misremember not, above a Year. And the Liquor was of such a nature, that if any Body had, though but for a few Moments, taken

taken out the Stople, I could easily discover it. But after all this while, one day that I was sitting in my Closet, at a good distance from the place in which the Vial stood, I heard a loud and brisk noise, almost like the report of a Pistol, and then perceiv'd that something came rolling to my Feet: I hastily took it up, and, found it to be the thicker and larger part of the Stople of my Vial, which of it self had flown off, leaving the remaining part so closely and strongly adjusted to the Neck, which serv'd it for a kind of Socket, that I could by no means pull it out thence. At this Accident I was not a little surpriz'd, considering the thickness of the Solid Glass, and that it had stood so long unmov'd, and that the bigger and heavier part of the Stople broke off from the other with such violence, and was carry'd from it by invisible motors to so great a distance. Which seem'd the more strange, because there was no shaking nor treading in the Room, that

could put the parts of the Glas into Motion, there being no Body present but my self, who was sitting quietly and studying.

To the IXth Chapter.

Observation III.

TO confirm what I have in the eighth Observation and elsewhere deliver'd about the latent Motion of Parts that may be in a Body not onely quiescent but solid, I shall here add a strange Instance, which was afforded me by a Diamond, belonging to an ingenious Merchant of that sort of Gems, who brought many fine ones out of the *East Indies*. For having at the Diamond-Mine it self, purchas'd amongst other Stones that grew there, a rough Diamond that he valued at about a hundred pound, and had well considered when he bought it; coming to look over his purchase again once
more,

more, about Ten Days or a Fort-
 night after, he was much surpriz'd
 to find, to his great loss, that this
 Diamond had of it self crack'd in se-
 veral places, and so became of little
 or no value, but as 'twas a Rarity:
 and indeed I could not without won-
 der, see so fair and hard a Stone so
 oddly spoil'd with Clefts, that seem'd
 to penetrate so very deep, that 'twas
 guess'd 'twould not be very difficult to
 pull the parts of the Stone asunder.
 And on this occasion he told me, that
 he had admir'd this Accident at first,
 much more than he did afterwards.
 For complaining of it to divers Mer-
 chants and Jewellers, that he met
 with in those Parts; he was told, that,
 though it seldom happen, yet 'twas
 no such wonderfull Accident; The
 like misfortune having befallen others
 as well as him.

A

Postscript.

THAT every common Reader may understand whatever is contain'd in the foregoing Treatises, the Publisher thought fit to english the Latin Passages that are not translated by the Authour.

I.

Tract I. Page 21.

Simon Pauli, in his ingenious *Treatise of Pestilential Fevers*, p. 71. tells us of a sick Frenchman, who liv'd several days after his Arm was cut off, though he was all the while most cruelly tortur'd by not ordinary Convul-

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sion

son Fits : But what is most observable is this that I and others sitting one day by his Bed-side, but not taking notice that the great Guns were going off from the King's Ships, he laying hold, and cherishing the Stamp of his Right Arm, broke out at every shot into these pitifull words : Jesus Maria, What do I not suffer ! I am quite bruis'd ; so troublesome, and insufferable to him was the shooting of the great Guns, though at a great distance, they being fired not in a joining Continent, but on the Balthick-sea.

II.

Platerus in the First Book of his Observations, p. 185. gives us this following Account, p. 26.

A Woman being fallen sick on a sudden complain'd continually of her being strangled, though there was no great appearance thereof ; this she ascribed chiefly to a certain Air, or Wind, which she was so sensible of,
that

that if any Body happen'd to come near her, she would immediately complain of her being choak'd, and died the second day of this odd Distemper : To which he adds, I have known several others complain of a not unlike Wind, and that they were in danger of being choak'd, if any body came near 'em : which I conceiv'd always to be a very ill sign.

III.

Page 57.

If you throw down an Animal into the hole of Viburg, which is in Carrelia, a Countrey in Scandia, 'tis reported that there breaketh immediately forth a great and insufferable sound, together with a strong wind : if a small weight be thrown into the Gap of Dalmatia, though, says Plinius, in a calm day, there is a storm immediately rais'd not unlike that which is occasion'd by a Whirlwind. Agricola de Natura eorum quæ effl. è terra, l. 4. c. 7.

IV.

I discharg'd a Pistol, being upon the top of the Hill, which at first made no greater noise than that which usually happens at the breaking of a small Rod: but after a little while the noise became stronger, and filled the lower parts of the Hill, the Valleys, and neighbouring Woods. Now coming down lower through Snow that had lain there several years, and having discharg'd again the Pistol, the noise became on a sudden louder than that of the greatest Guns. Which gave me some grounds to fear that the whole Hill, being thus shaken, should at length subside: this sound lasted half a quarter of an hour, till it had penetrated into the remotest Grotto's, whence the parts of the Air thrusting one another had been strongly reverberated: and because no such concavities were in the top of the Hill, the sound was first insensibly reverberated, till
coming

(155)

coming lower and nearer the Grotto's and Valleys it was strongly dash'd against 'em.

V.

Tract II. Page 48.

'Tis worthy our admiration, says Beguinus, that though in the Neighbourhood of Hydria, in the Countrey of Gloricia, where a great quantity of Mercury is found, the Pest almost every year rageth, yet it is always free from the Plague: and this was confirm'd to me by Persons of a very great Age, who said they had receiv'd it from their Ancestours.

VI.

An Attractive Pestilential Plaster.

Page 84.

Take of the Gums Sagapen, Ammoniac, Galbanum three ounces, of boil'd Turpentine, and Virgin-wax four ounces, and a half, of the Arsenical Loadstone well pulveris'd two ounces,

ounces, of Arons Root pulveris'd an ounce; let the Gums be depurated with the Vinegar of Squills, and boil'd to the consistency of a Plaster, and lastly weigh'd; then according to the usual method with other things make up a Plaster: cover the Carbuncle with this Plaster, and in a few hours it will draw out all the venom.

The true Preparation of the fore-
mention'd Arsenical Loadstone.

Take equal parts of Crystal-arsenick, of Sulphur of Glafs, of Crude Antimony: bray them to powder in an Iron Mortar, set them in a strong Glafs on a fire of Sand, till the Glafs be very hot, and the foremention'd Druggs melted like Pitch: which you shall know when having thrust a Thred into the bottom, the matter sticking to it does rope like Turpentine; which is a sign of its being well enough boil'd: remove then the Glafs from the fire, and when it is cold break it; reduce
the

the matter into small powder, and keep it for your use.

A Passage belonging to the Supplement.

Borel. de vi percussiois prop. CXI.
has these observable words. I was at Tauromenium in Sicily when the Mountain of Ætna broke out near Enna, a Town distant about thirty miles from Tauromenium; whilst the Gap did send out now and then with a great noise fire and flame all the Houses of Tauromenium were sensibly shaken: and it was observable that such Houses as look'd directly towards the Gap, were most of all agitated. Those that look'd otherwise shaking more slowly, upon which matter of fact he argues thus: had this trembling been occasion'd by the shaking of the Ground of Tauromenium, all the Houses had been equally shak'd, since this inequality of motion could not be ascrib'd to their different situation. Hence then
we

we must needs conclude that this agitation was produc'd by the impression of the Air upon the Walls of the Houses, which demonstrates to us the great efficacy of a sound, though at thirty miles distance.

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